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Report to Congressional Committees

March 2009

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

GAO

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Highlights

Highlights of GAO-09-326SP, a report to congressional committees

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

Why GAO Did This Study

This is GAO's seventh annual assessment of selected Department of Defense (DOD) weapon programs. The report examines how well DOD is planning and executing its weapon acquisition programs, an area that has been on GAO's high-risk list since 1990.

This year's report is in response to the mandate in the joint explanatory statement to the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009. The report includes (1) an analysis of the overall performance of DOD's 2008 portfolio of 96 major defense acquisition programs and a comparison to the portfolio performance at two other points in time—5 years ago and 1 year ago; (2) an analysis of current cost and schedule outcomes and knowledge attained by key junctures in the acquisition process for a subset of 47 weapon programs—primarily in development—from the 2008 portfolio; (3) data on other factors that could impact program stability; and (4) an update on changes in DOD's acquisition policies. To conduct our assessment, GAO analyzed cost, schedule, and quantity data from DOD's Selected Acquisition Reports for the programs in DOD's 2003, 2007, and 2008 portfolios. GAO also collected data from program offices on technology, design, and manufacturing knowledge, as well as on other factors that might affect program stability. GAO analyzed this data and compiled one- or two-page assessments of 67 weapon programs.

To view the full product, including the scope and methodology, click on GAO-09-326SP. For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

What GAO Found

Since 2003, DOD's portfolio of major defense acquisition programs has grown from 77 to 96 programs; and its investment in those programs has grown from $1.2 trillion to $1.6 trillion (fiscal year 2009 dollars). The cumulative cost growth for DOD's programs is higher than it was 5 years ago, but at $296 billion, it is less than last year when adjusted for inflation. For 2008 programs, research and development costs are now 42 percent higher than originally estimated and the average delay in delivering initial capabilities has increased to 22 months. DOD's performance in some of these areas is driven by older programs, as newer programs, on average, have not shown the same degree of cost and schedule growth.

Analysis of DOD Major Defense Acquisition Program Portfolios (Fiscal Year 2009 Dollars)

Portfolio status	Fiscal year 2003 portfolio	Fiscal year 2007 portfolio	Fiscal year 2008 portfolio
Number of programs	77	95	96
Total planned commitments	$1.2 trillion	$1.6 trillion	$1.6 trillion
Commitments outstanding	$724 billion	$875 billion	$786 billion
Change to total research and development costs from first estimate	37 percent	40 percent	42 percent
Change in total acquisition cost from first estimate	19 percent	26 percent	25 percent
Estimated total acquisition cost growth	$183 billion	$301 billion[a]	$296 billion
Share of programs with 25 percent or more increase in program acquisition unit cost	41 percent	44 percent	42 percent
Average delay in delivering initial capabilities	18 months	21 months	22 months

Source: GAO analysis of DOD data.

[a]Last year, GAO reported total acquisition cost growth for the fiscal year 2007 portfolio was $295 billion in fiscal year 2008 dollars. This figure is now expressed in fiscal year 2009 dollars.

For 47 programs GAO assessed in-depth, the amount of knowledge that programs attained by key decision points has increased in recent years; but most programs still proceed with far less technology, design, and manufacturing knowledge than best practices suggest and face a higher risk of cost increases and schedule delays. Early system engineering, stable requirements, and disciplined software management were also important as programs that exhibited these characteristics experienced less cost growth and shorter schedule delays on average. Program execution could be hindered by workforce challenges. A majority of the programs GAO assessed were unable to fill all authorized program office positions, resulting in increased workloads, a reliance on support contractors, and less personnel to conduct oversight.

In December 2008, DOD revised its policy for major defense acquisition programs to place more emphasis on acquiring knowledge about requirements, technology, and design before programs start and maintaining discipline once they begin. The policy recommends holding early systems engineering reviews; includes a requirement for early prototyping; and establishes review boards to monitor requirements changes—all positive steps. Some programs we assessed have begun implementing these changes.

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Abbreviations

ACS	Aerial Common Sensor
BAMS	Broad Area Maritime Surveillance
BMDS	Ballistic Missile Defense System
C-5 AMP	C-5 Avionics Modernization Program
C-5 RERP	C-5 Reliability Enhancement and Reengineering Program
CAIG	Cost Analysis Improvement Group
CDR	Critical Design Review
CSAR-X	Combat Search and Rescue Replacement Vehicle
DAMIRS	Defense Acquisition Management Information Retrieval System
DIMHRS	Defense Integrated Military Human Resources System
DOD	Department of Defense
EFV	Expeditionary Fighting Vehicle
FY	fiscal year
GPS	Global Positioning Systems
IOC	Initial Operational Capability
JAGM	Joint Air-to-Ground Missile
JLENS	Joint Land Attack Cruise Missile Dense Elevated Netted Sensor System
JLTV	Joint Light Tactical Vehicle
JTRS AMF	Joint Tactical Radio Systems Airborne, Maritime, Fixed-Station
LRIP	low-rate initial production
MDA	Missile Defense Agency
MDAP	Major Defense Acquisition Program
MIDS-JTRS	Multifunctional Information Distribution System - Joint Tactical Radio System
MUOS	Mobile User Objective System
NA	not applicable
OUSD (AT&L)	Office of the Under Secretary of Defense (Acquisition, Technology and Logistics)
PAUC	Program Acquisition Unit Cost
PDR	Preliminary Design Review
RDT&E	Research, Development, Test and Evaluation
SAR	Selected Acquisition Report
SFR	System Functional Review
SRR	System Requirements Review

TBD	to be determined
TRL	Technology Readiness Level
WIN-T	Warfighter Information Network - Tactical

United States Government Accountability Office
Washington, D.C. 20548

March 30, 2009

Congressional Committees

I am pleased to present GAO's seventh annual assessment of selected weapon programs. This report provides a snapshot of how well the Department of Defense (DOD) is planning and executing its major weapon acquisition programs—an area that has been on GAO's high-risk list since its inception in 1990. This report comes at an important time for DOD. DOD—like the rest of the federal government—is in a transition period as the new administration puts its management team in place and sets its priorities. DOD also faces a number of near-term and long-term fiscal pressures: extended operations in Afghanistan and Iraq have taken a toll on readiness, and rebuilding will be complex and costly; personnel costs for pay, benefits, and health care are rising; major weapon system programs are experiencing significant cost growth, and DOD is seeking to reshape and grow the force and modernize and transform capabilities.

While DOD's wants and needs continue to grow, overall, federal budget deficits are projected to increase significantly in the short term, and longer-term fiscal imbalances remain. As one of the largest discretionary items in the budget, DOD must improve its stewardship of taxpayer funds and the return on investment it receives from its expenditures on major weapon systems. Last year, we reported that the cumulative cost growth on DOD's major defense acquisition programs was $295 billion in fiscal year 2008 dollars ($301 billion in fiscal year 2009 dollars) and that the average delay in delivering promised capabilities to the warfighter was 21 months.

Our review this year indicates that while the overall performance of weapon system programs is still poor; there have been some modest improvements in DOD's acquisition outcomes: total cost growth on this year's portfolio of 96 major defense acquisition programs has decreased marginally compared to the 2007 portfolio, and programs started in recent years have more knowledge about technology and design at key points in the acquisition process. However, the cumulative cost overruns are still staggering—almost $296 billion in fiscal year 2009 dollars—and the problems are pervasive. Of DOD's 96 active major defense acquisition programs, 64 programs have reported increases in their projected cost since their initial cost estimate. While there are different ways to measure the extent and nature of cost growth, there is agreement between DOD and us on the sources of the problem: (1) programs are started with poor foundations and inadequate knowledge for developing realistic cost

estimates; (2) programs move forward with artificially low cost estimates, optimistic schedules and assumptions, immature technologies and designs, and fluid requirements; (3) changing or excessive requirements cause cost growth; and (4) an imbalance between wants and needs contributes to budget and program instability.

These problems have roots in not only the acquisition process, but the requirements and funding processes. A comprehensive approach will be needed to improve acquisition outcomes. To improve the efficiency of DOD's weapon system portfolio, it is essential for DOD to eliminate underperforming or lower priority programs, by completing or canceling them, and to initiate new programs, based on sound business cases and knowledge-based acquisition approaches. There is a need also to be mindful of the competing interests and other factors that have weakened the processes DOD now has, so that change can take place not only in the processes themselves, but also in the environment within which they must operate.

The time for change is now. The Secretary of Defense has identified acquisition as chief among the institutional challenges facing DOD and stated that efforts are underway to address it. DOD is off to a good start. In December 2008, DOD made major revisions to its acquisition policies, which address many of the problems that can be traced back to the acquisition system. The revisions, which are in line with our past recommendations, aim to provide key department leaders with the knowledge needed to make informed decisions before a program starts and to maintain discipline once it begins. To improve outcomes on the whole, though, DOD must ensure that these policy changes are immediately and consistently put into practice and reflected in decisions made on individual acquisitions. It must also fix accountability in an individual or individuals for its implementation. This will not be easy. Tough choices will need to be made about specific weapon systems, and stakeholders—from the military services to industry to the Congress—will have to play a constructive role in this process. We will do our part to monitor the progress of DOD's efforts in future assessments and continue to make recommendations that address

the broader challenges DOD faces with its requirements, funding, and acquisition processes.

Gene L. Dodaro

Gene L. Dodaro
Acting Comptroller General
of the United States

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This is GAO's seventh annual assessment of selected Department of Defense (DOD) weapon programs and the first in response to the mandate in the joint explanatory statement to the DOD Appropriation Act for fiscal year 2009.[1] This report provides a snapshot of how well DOD is planning and executing its major weapon acquisition programs—an area that has been on GAO's high-risk list since its inception in 1990. Over the next 5 years, DOD expects to invest about $329 billion (fiscal year 2009 dollars) on the development and procurement of major defense acquisition programs.[2] Given the nation's short term and long term fiscal challenges, the pressures on DOD to contain or reduce investments and to execute its existing programs in a cost-effective manner will likely continue to increase. Every dollar of cost growth on a DOD weapon system program represents a lost opportunity to pay for another national priority.

This report includes (1) an analysis of the overall performance of DOD's 2008 portfolio of 96 major defense acquisition programs and a comparison to the performance of the portfolio at two other points in time—5 years ago and 1 year ago;[3] (2) an analysis of current cost and schedule outcomes and knowledge attained by key junctures in the acquisition process for a subset of 47 weapon programs—primarily in development—from the 2008 portfolio; (3) data on other factors, such as cost estimating, requirements, software management, and program office staffing that could affect program stability; and (4) an update on DOD acquisition policies.

To conduct our analysis of DOD's portfolio of major defense acquisition programs, we obtained cost, schedule, and quantity data from DOD's

[1]See Explanatory Statement, 154 Cong. Rec. H 9427, 9526 (daily ed. Sept. 24, 2008) and the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, Division C, Department of Defense Appropriation Act Fiscal Year 2009, Pub. L. No. 110-329, § 4.

[2]All dollar amounts used in this report are in fiscal year 2009 constant dollars unless otherwise noted.

[3]Major defense acquisition programs (MDAP) are those identified by DOD that require eventual total research, development, test and evaluation (RDT&E) expenditures of more than $365 million or procurement expenditures of more than $2.19 billion in fiscal year 2000 constant dollars.

Selected Acquisition Reports (SAR) and from the Defense Acquisition Management Information Retrieval Purview system. We obtained information on the 67 programs in our individual assessments on the extent to which they follow knowledge-based practices for technology maturity, design maturity, production maturity, and software development from a data collection instrument provided to each program office. The 20 programs that were not major defense acquisition programs were excluded from our analysis of technology maturity, design stability, and production maturity.[4] Using a questionnaire, we also collected information from program offices on other aspects of program management including cost estimating, performance requirements changes, systems engineering, and program office staffing. We conducted this performance audit from August 2008 to March 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings based on our audit objectives. Appendix I contains detailed information on our scope and methodology.

[4]These programs include: eight Missile Defense Agency elements, six pre–major defense acquisition programs, three programs that are addressing issues raised in bid protests or have been canceled, two components of major defense acquisition programs, and one acquisition category II program. An acquisition category II program is defined as a program that does not meet the criteria for an acquisition category I program and is estimated to require eventual total RDT&E expenditures of more than $140 million or procurement expenditures of more than $660 million in fiscal year 2000 constant dollars.

DOD's 2008 Portfolio Shows Less Overall Cost Growth Than Last Year's Portfolio, but Other Indicators Remain Mixed

DOD's 2008 portfolio of major defense acquisition programs includes 96 programs—a net increase of 1 from a year ago and 19 since 2003.[5] The total investment in research, development, test and evaluation (RDT&E) and procurement funds for this portfolio is still about $1.6 trillion, while the funding needed to complete the programs in it has decreased by about $89 billion from a year ago. The total cost growth for DOD's portfolio of major defense acquisition programs is higher than it was 5 years ago, but at $296 billion, it is actually less than the 2007 portfolio's cost growth of $301 billion. To see how the common elements of each portfolio were performing over time, we identified and isolated 58 programs that have been part of the 2003 and 2008 portfolios and analyzed the estimated cost growth since 2003. For these programs, the total funding needed from fiscal year 2004 through their completion increased 27 percent, or $179 billion, between the December 2002 portfolio and the December 2007 portfolio. Development funding needs increased 46 percent, or $59 billion.

For DOD's 2008 programs, total research and development costs are now 42 percent higher than originally estimated, and the average delay in delivering initial capabilities is now 22 months. In addition, 42 percent of the programs reported a 25 percent or more increase in acquisition unit costs.[6] DOD's performance in some of these areas is driven by older, underperforming programs as newer programs, on average, have not yet shown the same degree of cost and schedule growth. In addition, while the total cost of the 2008 portfolio has grown by $48 billion over initial estimates because of increased purchases of certain weapon systems, this has been offset several times over by quantity decreases in other systems. On the whole, cost growth continues to have an adverse effect on the quantities programs are able to deliver to the warfighter.

The programs that make up DOD's 2008 portfolio have changed slightly. This is one of the reasons for the $5 billion decrease in total acquisition

[5]In 2008, four programs left the portfolio, a Chemical Demilitarization program, the Evolved Expendable Launch Vehicle, E-2C Hawkeye, and Land Warrior; four programs entered the portfolio, the Joint Mine Resistant Ambush Protected Vehicle, B-2 EHF Increment I, Space-Based Space Surveillance Block 10, and Large Aircraft Infrared Countermeasures; and one existing program, the Warfighter Information Network-Tactical was restructured and began reporting cost and schedule data separately for Increments 1 and 2.

[6]The program acquisition unit cost is the total cost for development and procurement of, and system-specific military construction for, the acquisition program divided by the number of fully-configured end items to be produced.

cost growth over the last year. Three programs—the Evolved Expendable Launch Vehicle, E-2C Hawkeye, and Land Warrior—left the portfolio, accounting for a net decrease of $15.6 billion in total acquisition cost growth.[7] The cost of the new and remaining programs in the 2008 portfolio has increased by about $10.7 billion since last year. Of the programs in the 2008 portfolio that reported relevant cost data, 75 percent, or 69 programs, reported increases in research and development costs since their first estimate, and 69 percent, or 64 programs, reported increases in total acquisition costs. Quantities have been reduced by 25 percent or more for 15 of the programs in the 2008 portfolio. Table 1 presents the results of our analysis of DOD's major defense acquisition program portfolios for 2003, 2007, and 2008 with indicators for development cost, total acquisition cost, unit cost, and schedule performance.

Table 1: Analysis of DOD Major Defense Acquisition Program Portfolios

Fiscal year 2009 dollars

	Fiscal year		
	2003	**2007**	**2008**
Portfolio size			
Number of programs	77	95	96
Total planned commitments	$1.2 trillion	$1.6 trillion	$1.6 trillion
Commitments outstanding	$724.2 billion	$875.2 billion	$786.3 billion
Portfolio indicators			
Change to total RDT&E costs from first estimate	37 percent	40 percent	42 percent
Change to total acquisition cost from first estimate	19 percent	26 percent	25 percent
Total acquisition cost growth	$183 billion	$301.3 billion[a]	$296.4 billion
Share of programs with 25 percent increase in program acquisition unit cost growth	41 percent	44 percent	42 percent
Average schedule delay in delivering initial capabilities	18 months	21 months	22 months

Source: GAO analysis of DOD data.

[7]DOD combined two previously separate programs, the Chemical Demilitarization Program-Chemical Materials Agency (Newport) and the Chemical Demilitarization Program-Chemical Materials Agency, leaving a single program, the Chemical Demilitarization Program--Chemical Material Agency.

Notes: Data were obtained from DOD's Selected Acquisition Reports (SAR) (dated December 2002, 2006, and 2007). In a few cases data were obtained directly from program offices. The number of programs reflects the programs with SARs; however, in our analysis we have broken a few SAR programs into smaller elements or programs. Not all programs had comparable cost and schedule data and these programs were excluded from the analysis where appropriate. Portfolio performance data do not include costs of developing Missile Defense Agency elements or the Defense Integrated Military Human Resources System (DIMHRS) program.

[a]The total acquisition cost growth for the 2007 portfolio was $295 billion in 2008 constant dollars.

The overall performance of this portfolio is one indicator of how well DOD's acquisition system generates the return on investment it promises to the warfighter, Congress, and the taxpayer. The surest way to improve its performance is by reducing the number of underperforming programs, by either completing or canceling them, and ensuring that new programs are founded on sound business cases and follow a knowledge-based approach, as embodied in DOD's recently revised acquisition policy, as they enter the portfolio.[8] This approach must begin with strong systems engineering analysis that balances a weapon system's requirements with available resources.

Our analysis of DOD's 2008 portfolio allows us to make several observations about the portfolio's balance between its largest programs and smaller ones, the relative performance of newer programs, and the delivery of capabilities to the warfighter.

- **Ten of DOD's largest acquisition programs, commanding about half the overall acquisition dollars in the portfolio, have experienced significant cost growth, and have seen quantities reduced by almost a third.** The total estimated development cost for these 10 programs has grown 32 percent from initial estimates, from about $134 billion to over $177 billion. Overall acquisition cost has grown by 13 percent while quantities across all 10 programs have been reduced by 32 percent, from 6,645 to 4,503. Taken as a whole, total program acquisition unit costs on these programs have also grown significantly. The two largest programs—the Joint Strike Fighter and Future Combat Systems—still represent significant cost risk moving forward and will dominate the portfolio for years. Since these programs consume such a large portion of the funding that DOD spends on

[8]Part of DOD's acquisition policy is DOD Directive 5000.01, *The Defense Acquisition System*, which describes the management principles for DOD's acquisition programs, and DOD Instruction 5000.02, *The Operation of the Defense Acquisition System*, which outlines a framework for managing acquisition programs. Collectively, these are referred to as the 5000 series.

research and development and procurement, their performance also affects other major weapon acquisitions, smaller acquisition programs, and DOD's ability to fund and acquire other supplies and equipment.

Table 2 provides a summary of 10 of the largest major defense acquisition programs. We do not include the Ballistic Missile Defense System (BMDS) and the DDG-51 in this list because comparable cost and quantity data were not available for either program.

Table 2: Changes in Costs and Quantities for 10 of the Highest-Cost Acquisition Programs

	Total cost (fiscal year 2009 dollars in millions)		Total quantity		Acquisition unit cost
Program	First full estimate	Current estimate	First full estimate	Current estimate	Percentage change
Joint Strike Fighter	206,410	244,772	2,866	2,456	38
Future Combat System	89,776	129,731	15	15	45
Virginia Class Submarine	58,378	81,556	30	30	40
F-22A Raptor	88,134	73,723	648	184	195
C-17 Globemaster III	51,733	73,571	210	190	57
V-22 Joint Services Advanced Vertical Lift Aircraft	38,726	55,544	913	458	186
F/A-18E/F Super Hornet	78,925	51,787	1,000	493	33
Trident II Missile	49,939	49,614	845	561	50
CVN 21 Nuclear Aircraft Class Carrier	34,360	29,914	3	3	-13
P-8A Poseidon Multi-mission Maritime Aircraft	29,974	29,622	115	113	1

Source: GAO analysis of DOD data.

- **New programs in the portfolio are performing better than older programs.** For programs less than 5 years from inception, total costs have not significantly changed since their first estimates. Older programs experienced much higher levels of cost growth—for example, average program acquisition unit cost increases on older programs ranged from 38 percent to 127 percent. It is not yet certain that newer programs will continue to perform well, as we have previously found

that most program cost growth does not materialize until later—after the critical design review. However, newer programs may benefit from recent changes in DOD's acquisition policies and practices. For example, on programs in technology development, such as the Joint Light Tactical Vehicle and Joint Air-to-Ground Missile, DOD is demanding more prototyping and risk reduction prior to initiating system development. Table 3 provides various indicators of cost and schedule performance stratified by age for the 80 programs in the 2008 DOD portfolio that had complete cost, schedule, and quantity information.

Table 3: Changes in Program Cost and Schedule by Age of Program

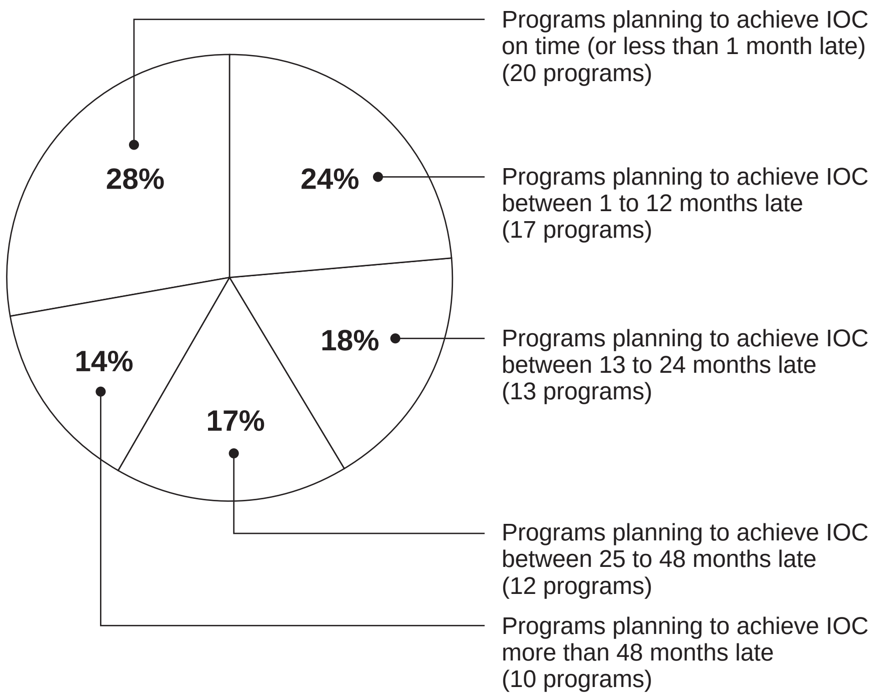
Age of program	Overall change in RDT&E costs (percent)	Overall change in total costs (percent)	Average increase in acquisition unit costs (percent)	Average change in quantities (percent)	Average number of months late	Number of programs
15 or more years since development start	47	19	127	-39	37	10
10 to 14 years since development start	73	53	38	52	26	17
5 to 9 years since development start	37	31	55	9	22	25
Less than 5 years since development start	12	11	1	1	5	28

Source: GAO analysis of DOD data.

- **Promised capabilities continue to be delivered later than planned.** In addition to delivering fewer quantities than expected, DOD continues to experience delays in delivering new or modified weapon systems to the warfighter as promised. Acquisition delays can lead to loss of program credibility with stakeholders, increased acquisition costs, new systems not being available to meet the needs of warfighters during combat operations, and the continued use of less capable systems with questionable reliability and high operating costs. The average delay in delivering initial capabilities to the warfighter increased to 22 months for programs in DOD's 2008 portfolio, compared with 21 months for programs in the 2007 portfolio (see table 1). Only 28 percent of DOD's major defense acquisition programs currently estimate that they will deliver on time or ahead of schedule, while just under one-

half report they will have a delay of 1 year or more in delivery of an initial operational capability (see fig. 1).[9]

Figure 1: Schedule Delays for Major Weapon Systems as of December 2007



Source: GAO analysis of DOD data.

Note: Initial operational capability (IOC) is generally achieved when some units or organizations that are scheduled to receive a system have received it and have the ability to employ and maintain it.

Between the issuance of the December 2006 and December 2007 SARs, 20 major defense acquisition programs reported delays in achieving initial operational capability, while 4 reported accelerating delivery of initial operational capabilities—a margin of five to one. Of those 20 programs, 16 reported delays of 3 months or more in delivering initial operational capabilities and 6 programs reported additional delays of 1 year or more.

[9]We assessed delivery time frames using the program's planned dates for achieving initial operational capability or other equivalent dates. Delays of less than 1 month are considered on-time for the purposes of this analysis.

Programs Examined Have More Knowledge at Key Decision Points, but Still Move forward Prematurely

Good acquisition outcomes require the use of a knowledge-based approach to product development that demonstrates high levels of knowledge before significant commitments are made. Achieving the right knowledge at the right time enables leadership to make informed decisions about when and how best to move into various acquisition phases. In essence, knowledge supplants risk over time. This building of knowledge consists of information that should be gathered at three critical points over the course of a program:

- **Knowledge point 1**: **Resources and requirements match.** Achieving a high level of technology maturity by the start of system development is an important indicator of whether this match has been made.[10] This means that the technologies needed to meet essential product requirements have been demonstrated to work in their intended environment. In addition, the developer has completed a preliminary design of the product that shows the design is feasible.

- **Knowledge point 2**: **Product design is stable.** This point occurs when a program determines that a product's design will meet customer requirements, as well as cost, schedule, and reliability targets. A best practice is to achieve design stability at the system-level critical design review, usually held midway through system development. Completion of at least 90 percent of engineering drawings at this point provides tangible evidence that the product's design is stable, and a prototype demonstration shows that the design is capable of meeting performance requirements.

- **Knowledge point 3**: **Manufacturing processes are mature.** This point is achieved when it has been demonstrated that the developer can manufacture the product within cost, schedule, and quality targets. A best practice is to ensure that all critical manufacturing processes are in statistical control—that is, they are repeatable, sustainable, and capable

[10]The start of system development, as used here, indicates the point at which significant financial commitment is made to design, integrate, and demonstrate that the product will meet the user's requirements and can be manufactured on time, with high quality, and at a cost that provides an acceptable return on investment. Under the revised 5000 series, this phase is now called engineering and manufacturing development. Engineering and manufacturing development follows the materiel solution analysis and technology development.

of consistently producing parts within the product's quality tolerances and standards—at the start of production.

A knowledge-based acquisition approach is a cumulative process in which certain knowledge is acquired by key decision points before proceeding. In other words, demonstrating technology maturity is a prerequisite for moving forward into system development, during which the focus should be on design and integration.

For 47 weapon programs in DOD's 2008 portfolio, we assessed the knowledge attained by key junctures in the acquisition process, as well as cost and schedule performance. These programs are primarily in development and, therefore, most relevant to current decisions about which programs should receive substantial investments of research and development funding now and large amounts of procurement funding in the future. In recent years, there have been increases in the amount of technology, design, and production knowledge that these programs have attained by key points in the acquisition process. We also found that some programs are conducting systems engineering reviews before starting development, which can help ensure that requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints. However, while these are signs of progress, the number and percentage of programs meeting our knowledge point criteria remains low and virtually unchanged from last year; none of the 47 programs in our assessment have attained or are on track to attain the requisite amount of technology, design, and production knowledge by each of the key junctures in the acquisition process.[11] This lack of knowledge makes initial cost estimates less predictable and increases the risk of cost growth from those initial estimates.

Our analysis of 47 programs from DOD's 2008 portfolio allows us to make the following observations about DOD's management of technology, design, and manufacturing risks and its use of testing and early systems engineering to reduce these risks. The total acquisition cost growth for 43 of these programs with comparable initial and latest estimates is 18 percent. Research and development costs were 38 percent higher than initially estimated for 44 programs. The promised delivery of capability has

[11]Not all programs provided information for every knowledge point or had reached all of the knowledge points—development start, design review, or production start.

slipped, on average, by 25 months for 36 programs reporting this data (see table 4).

Table 4: Outcomes for Weapon Programs in 2009 Assessment

Performance indicators	Outcomes to date	Number of programs with available data
Increase in RDT&E costs from first estimate (percent)	38	44
Increase in total acquisition cost from first estimate (percent)	18	43
Share of programs with more than 25 percent growth in program acquisition unit cost (percent)	38	40
Share of programs with more than 25 percent decrease in planned quantities (percent)	20	41
Average delay in delivering initial capabilities (months)	25	36

Source: GAO analysis of DOD data.

Note: Not all programs in our assessment have entered system development or had comparable first and latest estimates to measure outcomes. These programs were excluded from this analysis. Details of our scope and methodology can be found in app. I.

- **Newer programs are beginning with higher levels of technology maturity.**[12] In 2003, DOD revised its primary acquisition policy to state that technologies should be demonstrated in a relevant environment prior to starting an acquisition program.[13] In 2006, this standard became a statutory requirement for all major defense acquisition programs seeking to enter system development.[14] Since 2003, there has been a significant increase in the percentage of technologies demonstrated in a relevant environment by the start of system development (see fig. 2). While only one of the five programs that entered system development since 2006 had fully mature critical technologies—that is, demonstrated

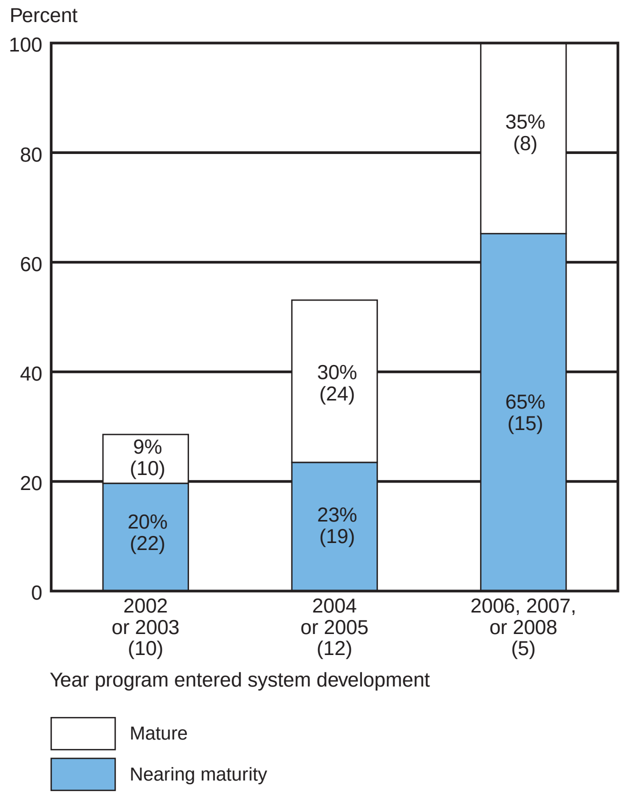
[12]Demonstration in a relevant environment is Technology Readiness Level (TRL) 6. See app. III for a detailed description of TRLs.

[13]In December 2008, DOD revised its acquisition policy for major defense acquisition programs. We did not assess programs' compliance with these revisions.

[14]National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 801, codified at 10 U.S.C. § 2366b.

in a realistic environment—the other four programs reported that all their critical technologies had at least been demonstrated in a relevant environment, in accordance with the DOD and statutory criteria. Overall, only 4 of the 36 programs in our assessment that provided data on technical maturity at development start did so with fully mature critical technologies. On average, these 4 programs have experienced 30 percent less growth in research and development costs over their first estimates than the programs that did not demonstrate technology maturity by the start of system development.

Figure 2: Percentage of Technologies That Were Mature and Nearing Maturity When Programs Entered System Development



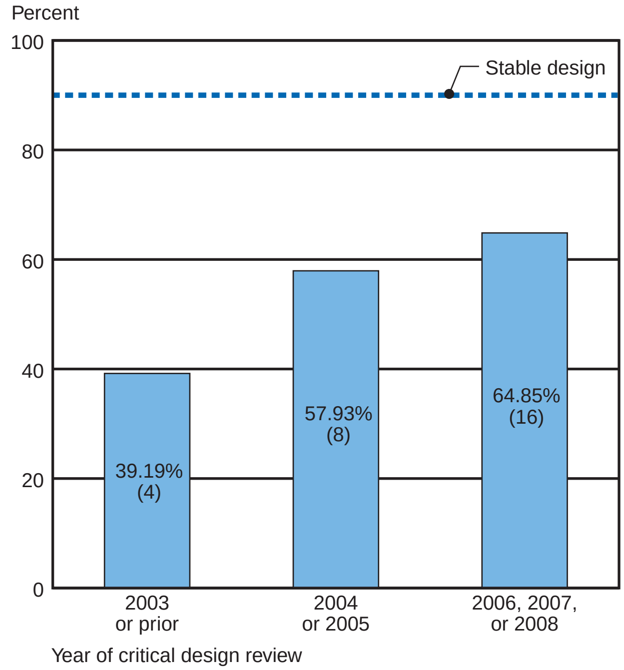
Source: GAO analysis of DOD data.

Note: The number of programs entering system development are in parentheses under the years. The number of critical technologies for those programs are in parentheses in the bars.

- **Programs are still concurrently developing technologies, finalizing designs, and demonstrating manufacturing processes, which can lead to cost and schedule inefficiencies and avoidable rework.** Only 14 of 39 programs that provided data have or plan to have demonstrated all of their technologies in a realistic environment prior to the system-level critical design review, at which point the system's design should be stable. Further, at the time a production decision is made, when DOD's Technology Readiness Assessment handbook states that a system's critical technologies should be demonstrated in a realistic environment, 8 of 40 programs will have failed to demonstrate that all of their critical technologies functioned at that level. In total, of the 268 critical technologies identified during our assessment, 50 percent, or 134 technologies, were accepted by a program office into a product's design based on no more than a laboratory demonstration of basic performance, technical feasibility, and functionality, and not on a representative model or prototype demonstration close to form and fit (size, weight, materials) in a relevant or realistic environment. We reported a similar percentage of immature technologies being accepted in programs in our 2008 assessment.

- **Programs that have held design reviews in recent years reported higher levels of design knowledge.** Knowing a product's design is stable before system demonstration reduces the risk of costly design changes occurring during the manufacturing of production representative prototypes—when investments in acquisitions become more significant. Of the 29 programs in our assessment that have held a system-level critical design review, 7 reported having a stable design. Similar to technology maturity, the level of design knowledge attained by the critical design review has been increasing over time (see fig. 3). However, designs, on average, are still far from stable. For the 24 programs in our assessment that have held a critical design review since 2003, the average percentage of total expected design drawings releasable at this review has increased from 58 percent to 65 percent; and 5 of the 16 programs that have held a critical design review since 2006 reported having stable designs. However, 4 of these programs still have critical technologies that have not been demonstrated in a realistic environment at the time of the critical design review, which increases the risk of design changes and rework until the development of those technologies is complete.

Figure 3: Average Percent of Total Expected Design Drawings That Are Releasable at Critical Design Review



Source: GAO analysis of DOD data.

Note: Number of programs in parentheses.

- **More programs are identifying critical manufacturing processes.** Capturing critical manufacturing knowledge before entering production helps ensure that a weapon system will work as intended and can be manufactured efficiently to meet cost, schedule, and quality targets. Identifying key product characteristics and the associated critical manufacturing processes is a key initial step to ensuring production elements are stable and in control. While only 4 of the 23 programs that have already made a production decision identified key product characteristics or associated critical manufacturing processes, 4 of the 17 programs that are scheduled to make a production decision in the next 3 years have already done so. At least 2 of those 4 programs—the Multifunctional Information Distribution System-Joint Tactical Radio System (MIDS-JTRS) and the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)—have predicted that they will have all of their critical manufacturing processes in statistical control by the time a production decision is made.

- **Programs are not testing fully integrated prototypes early enough.** In addition to demonstrating that the system can be built efficiently, production and postproduction costs are minimized when a fully integrated, capable prototype is demonstrated to show that the system will work as intended and in a reliable manner. The benefits of this testing are maximized when the tests are completed prior to a production decision because making design changes after production begins can be both costly and inefficient. Of the 33 programs that reported that they were going to test a fully configured, integrated, production-representative prototype, 17 programs planned to do so prior to making a production decision.[15] Of the 11 programs that have already made a production decision, only 4 had tested such a prototype prior to that decision. While another 2 programs tested a production-representative prototype within 6 months of the production decision, the remaining programs, on average, conducted or plan to conduct this type of test almost 5 years after that decision. For instance, the Presidential Helicopter program simultaneously started system development and made a production decision in January 2005. However, the program does not intend to test a fully configured, integrated, production-representative prototype until July 2009.

- **Early system engineering has proven helpful to programs that have employed it.** Early systems engineering, ideally beginning before a program is initiated and a business case is set, is critical to ensuring that a product's requirements are achievable and designable given available resources. Before starting development, programs should hold systems engineering events such as the system requirements review, system functional review, and preliminary design review to ensure that requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints. A majority of the 41 programs in our assessment that responded to our questionnaire conducted these reviews, but few programs completed them before development start, making it unlikely the programs will reap the full benefit of the information these reviews provide. For example:

[15]This analysis is based on responses received from the questionnaire submitted to the 67 programs we individually assessed.

- Only 12 of the 31 programs that held a system requirements review did so before development start. The remaining programs held the review, on average, 27 months after development start.[16]

- Only 8 of the 23 programs that held a system functional review did so before development start. The remaining programs held the review, on average, 31 months after development start.[17]

- Only 4 of the 36 programs that held a preliminary design review did so before development start; the remaining programs held the review, on average, 31 months after development start.[18]

As evidence of the benefits of early systems engineering, we found that the programs in our assessment that conducted these systems engineering events prior to development start experienced, on average, over 20 percent less research and development cost growth than programs that conducted these reviews after development start (see fig. 4). These programs also often experienced a shorter delay in delivery of initial operational capability. On average, the programs that conducted a system requirements review or a system functional review prior to development start experienced delays in the delivery of initial operational capabilities that were, respectively, 8 and 9 months shorter than programs that held these reviews after development start.[19]

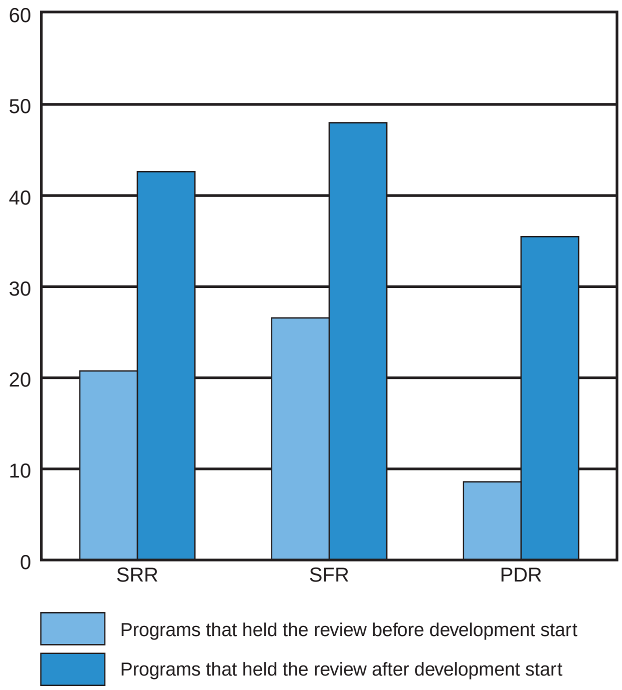
[16]The purpose of a system requirements review (SRR) is to ensure that the system under review can proceed into system development and that all system and performance requirements are consistent with cost, schedule, risk, and other system constraints.

[17]The purpose of a system functional review (SFR) is to ensure that the system can proceed into preliminary design and that all system and functional performance requirements are defined and are consistent with cost, schedule, risk, and other system constraints.

[18]The purpose of a preliminary design review (PDR) is to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost, schedule, risk, and other system constraints.

[19]This analysis is based on responses received from the questionnaire submitted to the 67 programs we individually assessed.

Figure 4: Average RDT&E Cost Growth for Programs since First Estimates by Timing of Key Systems Engineering Events



Source: GAO analysis of DOD data.

In December 2008, DOD, consistent with our past recommendations, established in policy that a preliminary design review should be conducted before development start, or as soon as possible after program initiation, suggesting that it be done prior to establishing initial cost, schedule, and performance estimates for its business case. This is a positive development. If the new policy is implemented consistently, completion of these reviews before development start should become more common, which could reduce poor performance and optimize acquisition outcomes on future programs.

Other Factors Can Also Affect Program Stability, Execution, and Outcomes

In addition to collecting and analyzing data on cost and schedule performance and the attainment of knowledge at key junctures, we collected and assessed data on other areas related to DOD's management of its weapon programs, including cost estimating, performance requirements, software management, and program office staffing.[20] For the programs in our assessment, we confirmed that programs with requirements changes after system development start experienced higher levels of cost growth and longer delays in delivering initial operational capabilities to the warfighter. In addition, a majority of the programs that provided data could face cost and schedule problems because of substantial changes in the amount of software lines of code required for the system to function. Further, program execution could be hindered by workforce challenges. A majority of the programs we assessed were unable to fill all authorized program office positions, resulting in increased workloads, a reliance on support contractors, and less personnel to conduct oversight.

Our analysis of data collected from programs in our assessment allows us to make the following observations about cost estimating, performance requirements, software management, and program office staffing. We have previously identified poor cost estimating practices, requirements changes, and increases in software lines of code as sources of program instability that can contribute to cost growth and schedule delays. Further, we have previously found shortages of acquisition professionals in certain areas, such as cost estimating and contracting; and program offices have expressed concerns about not having adequate personnel to carry out program office roles.

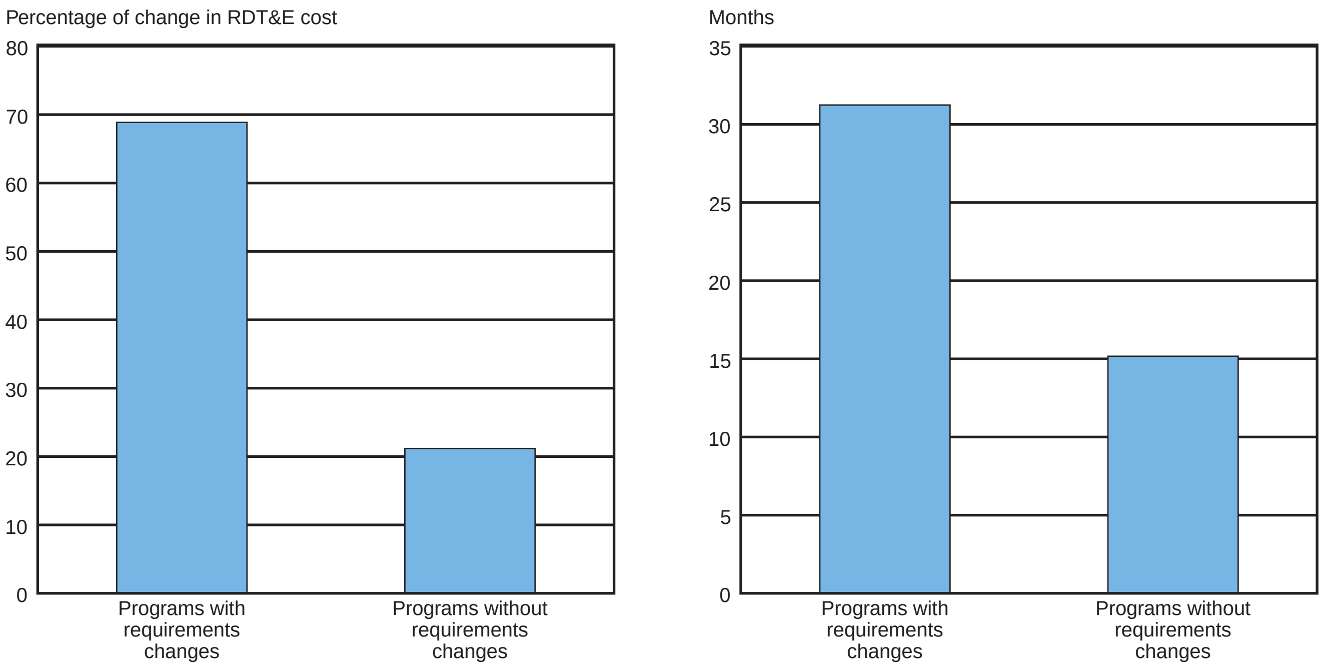
- **Most programs used initial cost estimates from sources that in the past have been found to be less reliable.** A reliable cost estimate helps ensure a program's projected funding needs are adequate to execute the program. The Office of the Secretary of Defense's Cost Analysis Improvement Group (CAIG) reviews these estimates and provides new estimates based on the program's assumptions. Less than a quarter of the 48 programs in our assessment that provided data used the CAIG estimate as a basis for the program's baseline, while almost 70

[20]See app. I for our detailed scope and methodology on the programs that responded to the questionnaire and data collection instruments used in our analysis of cost estimating, requirements changes, software management, and program office staffing.

percent of the programs used the program office or service cost estimate. While cost estimates from the CAIG can underestimate a program's costs by billions of dollars, we have previously found that these independent estimates generally underestimate costs by a smaller amount than program office and service estimates.

- **Programs that changed key system requirements after starting development had added instability.** Twenty-two of the 52 programs in our assessment that provided data on requirements changes had at least one change (addition, reduction, or deferment) in a key performance parameter since development start. The average increase in research and development costs over first estimates for these 22 programs was more than three times greater than for those programs with no requirements changes. The average delay in the delivery of initial operational capabilities was also twice as long for programs with changes in key performance parameters as for programs with no requirements changes (see fig. 5). Further, 6 programs with requirements changes experienced a decrease in planned quantities of 25 percent or more compared to only 2 programs without requirements changes.

Figure 5: Requirements Changes, Research and Development Cost Growth, and Delays in Providing Initial Operational Capabilities



Source: GAO analysis of DOD data.

- **Programs with software growth experienced greater cost growth and longer schedule delays.** Measuring changes in the expected amount of software code that needs to be developed for the program is one of the key metrics used by leading software developers to monitor software development efforts. Fourteen of the 33 programs in our assessment that provided data on software estimated that the number of lines of code required for the system to function has grown or will grow by 25 percent or more since development start. Since development start, these programs, on average, experienced a 40 percent growth in research and development cost and an almost 38-month delay in fielding initial operational capabilities, compared to 12 percent and 8 months for programs with lower levels of software growth.

- **Acquisition programs are not able to fill all the government positions they have been authorized.** The inability of programs to fully staff their program offices may hinder program execution. While 46 of the 59 programs that responded to questions on program office

staffing reported receiving authorization for all of the positions requested, only 42 percent were able to fill all the positions authorized. As a result, program offices reported degradation in oversight, delays in certain management and contracting activities, increased workloads for existing staff, and a reliance on support contractors to fill some voids. This reliance on support contractors has increased since last year's assessment. For the 61 programs in our current assessment that responded, support contractors constituted approximately 41 percent of the program office staff compared to 36 percent last year (see table 5). The greatest numbers of support contractors are in engineering and technical positions; however, on a percentage basis, they are most prevalent in administrative support roles.

Table 5: Program Office Composition for 61 DOD Programs

Percentage of staff

	Program management	Engineering and technical	Contracting	Other business functions	Administrative support	Other	Total
Military	40	7	5	4	3	4	**9**
Civilian government	34	40	78	49	32	33	**41**
Total government	**74**	**47**	**83**	**53**	**34**	**37**	**51**
Support contractors	26	40	17	45	64	62	**41**
Other nongovernment	1	12	Less than 1	2	2	1	**8**
Total nongovernment	**26**	**53**	**17**	**47**	**66**	**63**	**49**

Source: GAO analysis of DOD data.

Notes: Totals may not add due to rounding.

[a]Other nongovernment includes federally funded research and development centers, universities, and affiliates.

DOD's Recent Policy Changes Put an Emphasis on Early Systems Engineering and Knowledge-Based Acquisition Strategies

In December 2008, DOD revised its policy governing major defense acquisition programs in ways that aim to provide key department leaders with the knowledge needed to make informed decisions before a program starts and to maintain disciplined development once it begins. The revised policy recommends the completion of key systems engineering activities before development start, includes a requirement for early prototyping, establishes review boards to identify and mitigate technical risks and evaluate the effect of potential requirements changes on ongoing programs, and incorporates program manager agreements to establish achievable and

measurable annual plans and management accountability. These changes are consistent with the knowledge-based approach to weapons development that we have recommended in our work. If implemented, these changes can help programs to replace risk with knowledge, thereby increasing the chances of developing weapon systems within cost and schedule targets while meeting user needs. Some of these changes are beginning to be implemented on the programs in our assessment. These are encouraging signs, but to improve outcomes on the whole, DOD must ensure that these policy changes are consistently implemented and reflected in decisions on individual programs.

New Policy Incorporates Knowledge-Based Acquisition Practices

DOD's revisions to its acquisition policy and processes incorporate a substantial number of the best practices we identified in our previous work. The revised policy includes guidance to better ensure that programs have demonstrated a certain level of technology maturity, design stability, and production maturity before proceeding into the next phase of the acquisition process. In the area of technology maturity, the guidance put in place by this policy is reinforced by a statutory requirement that decision makers certify that a program meets specific criteria at Milestones A and B. This provides a meaningful control for assuring that the guidance is followed. In a 2003 report, we assessed DOD's 2003 acquisition policy against a best practices model based on a knowledge-based approach and found that it contained only some of these knowledge-based practices.[21] In particular, it lacked guidance for demonstrating design stability and production maturity before moving into development and production. The policy, as revised in December 2008, includes guidance for most of those knowledge-based practices. For example, the revised policy notes that the milestone decision authority shall conduct a formal program assessment following the system level critical design review before the program can proceed.[22] However, even with this new policy in place, DOD will need to

[21]GAO, *Defense Acquisitions: DOD's Revised Policy Emphasizes Best Practices, but More Controls Are Needed*, GAO-04-53 (Washington, D.C: Nov. 10, 2003).

[22]This review is the post–critical design review. The milestone decision authority, as constructed by the Office of the Under Secretary of Defense (Acquisition, Technology and Logistics), is an entity with approval authority for a program's structure, including type and number of decision points, and entry into major acquisition phases based on milestone decisions. Each milestone decision, which typically addresses program progress, risks, affordability, trade-offs, acquisition strategy updates, and development of exit criteria for the next phase, results in a decision to initiate, continue, advance, or terminate a program work effort or phase.

address the inconsistent implementation that has hindered its past efforts to reform its acquisition policies.

Implementation of Changes Is Key to Improved Outcomes

The success of DOD's efforts to improve weapon acquisition outcomes depends, in part, on the extent to which the letter and spirit of its revised policies and recent statutory changes are implemented in practice. While it is too early to comprehensively review the implementation of DOD's revised acquisition policies and other statutory changes, we observed that DOD has begun to implement some of these changes on the programs we assessed. We noted that plans are in place to utilize competitive prototyping; programs have received certifications that specific criteria have been met before development start; configuration steering boards have been held; and program manager performance agreements have been put in place.

The revised technology development phase includes a competitive prototyping requirement for systems or key system elements, which should provide a stronger basis for analyzing and refining requirements, ensuring more knowledgeable initial cost estimates, and making an appropriate match between requirements and available resources before programs begin. Improved technology with appropriately matched requirements, funds, and schedule could make initial development cost estimates and delivery times much more accurate and predictable at program initiation. The Joint Air-to-Ground Missile and Joint Light Tactical Vehicle programs have indicated that they plan to use competitive prototyping during technology development to mature technologies and reduce risks. However, DOD has also approved acquisition strategies with only one prototype for the WIN-T and Expeditionary Fighting Vehicle based on a cost and benefit analysis of using a competitive approach.

Certifications for entry into the technology development and system development phases require the development of critical knowledge before programs can proceed, for example, the successful demonstration of technology. Requiring these demonstrations of knowledge has the potential to increase program stability and predictability and reduce acquisition cycle time. Further, eliminating programs with inadequate technology and questionable affordability, funding, viability, and sustainability early in the acquisition cycle could prevent DOD from unnecessarily expending valuable resources. Five of the programs we assessed—CSAR-X, KC-X, JTRS AMF, BAMS, and GPS IIIa—received certifications to enter system development. Two programs, CSAR-X and KC-X, awarded contracts after

certification, but these awards were the subject of bid protests and therefore the programs have not begun development. According to Office of the Under Secretary of Defense for Acquisition, Technology and Logistics officials, these programs will likely require recertification prior to any future contract awards.

New configuration steering boards are implementing annual and event-driven program reviews to ensure weapon system requirements do not exceed resources, and, according to Office of the Under Secretary of Defense for Acquisition, Technology and Logistics officials, to identify options to reduce cost, speed up delivery of capability, or provide a reserve against emergent technical risks. Twenty-two of the programs we assessed have held configuration steering boards to date. A watchful eye on issues affecting cost and schedule could rectify delays in the delivery of capabilities and prevent reductions in purchased quantities. The MUOS program identified several descoping options at its configuration steering board resulting in 10 contract modifications that relaxed requirements to offset higher than expected costs. Following the WIN-T configuration steering board, the program was restructured into multiple increments.

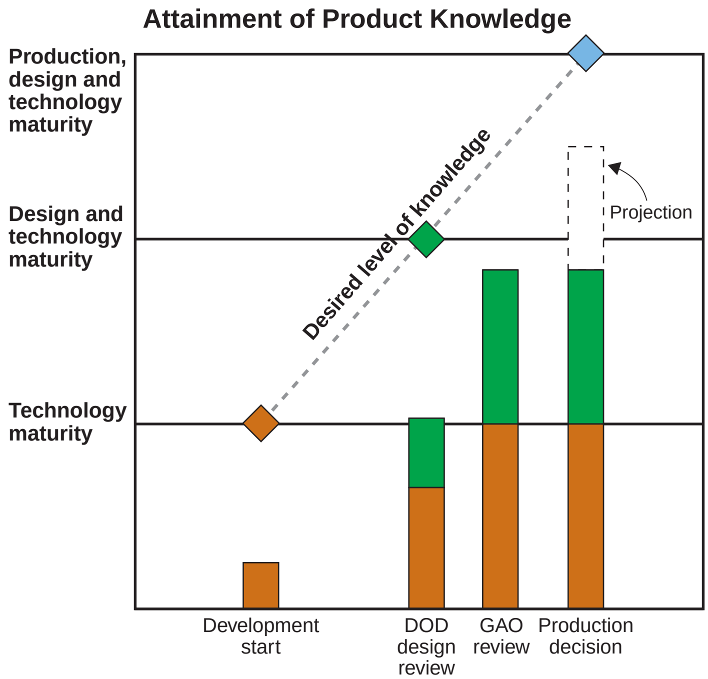
Program manager performance agreements offer management accountability and establish achievable and measurable annual plans. Thirty-nine programs we assessed have program manager performance agreements in place. However, there are currently no specific consequences for not meeting the terms of the agreement or direct benefits for meeting the terms of the agreement. DOD is using existing personnel policies to evaluate program manager performance and provide rewards for good performance, such as promotions and bonuses, or penalties for bad performance, such as removal as program manager or lack of promotion.

How to Read the Knowledge Graphic for Each Program Assessed

For our two-page assessments, we depict the extent of knowledge gained by key points in a program using a stacked bar graph and provide a narrative summary at the bottom of the first page of each assessment. As illustrated in figure 6, the knowledge graph is based on three knowledge points. The key indicators for the attainment of knowledge are technology maturity (in orange), design stability (in green), and production maturity (in blue). A “best practice” line is drawn based on the ideal attainment of the three types of knowledge at the three knowledge points. The closer a program’s attained knowledge is to the best practice line; the more likely the weapon will be delivered within estimated cost and schedule. A

knowledge deficit at development start—indicated by a gap between the technology maturity attained and the best practice line—means the program proceeded with immature technologies and faces a greater likelihood of cost and schedule increases as risks are discovered and resolved.

Figure 6: Depiction of a Notional Weapon System's Knowledge as Compared with Best Practices



Source: GAO.

An interpretation of this notional example would be that system development began with critical technologies that were partially immature, thereby missing knowledge point 1 indicated by the orange diamond. By the design review, technology knowledge had increased, but all critical technologies were not yet mature, and only 33 percent of the program's design drawings were releasable to the manufacturer. Therefore, knowledge point 2, as indicated by the green diamond, was not attained. At the time of GAO's review, this program had matured all of its critical technologies and released approximately 75 percent of its design drawings. When the program plans to make a production decision, it expects to have

released all of its design drawings and have half of its critical manufacturing processes in statistical control. The expected knowledge at this future point is captured in the outlined region marked “projection.” This program is not projected to reach knowledge point 3, indicated by the blue diamond, by the time it makes a production decision.

Assessments of Individual Programs

This section contains assessments of individual weapon programs. Each assessment presents data on the extent to which programs are following a knowledge-based approach to system development and other program information. In total, we present information on 67 weapon programs. Forty-seven are major defense acquisition programs, most of which are in development. We also collected information and provided profiles on 20 additional programs. These programs include

- 8 MDA elements,
- 6 pre–major defense acquisition programs,
- 3 programs in the bid protest process at the time of our review or canceled,
- 2 components of major defense acquisition programs, and
- 1 acquisition category II program.

Our assessments of 60 programs are captured on 2-page assessments discussing technology, design, and manufacturing knowledge obtained and other program issues. The other 7 programs are described in a 1-page format that describes their current status.

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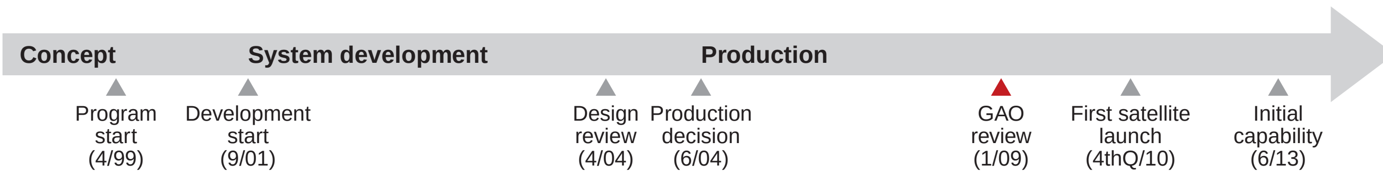
Advanced Extremely High Frequency (AEHF) Satellites

The Air Force's AEHF satellite system will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters. The program includes satellites and a mission control segment. Terminals used to transmit and receive communications are acquired separately by each service. AEHF is an international partnership program that includes Canada, the United Kingdom, and the Netherlands. We assessed the satellite and mission control segments.

Source: Lockheed Martin.



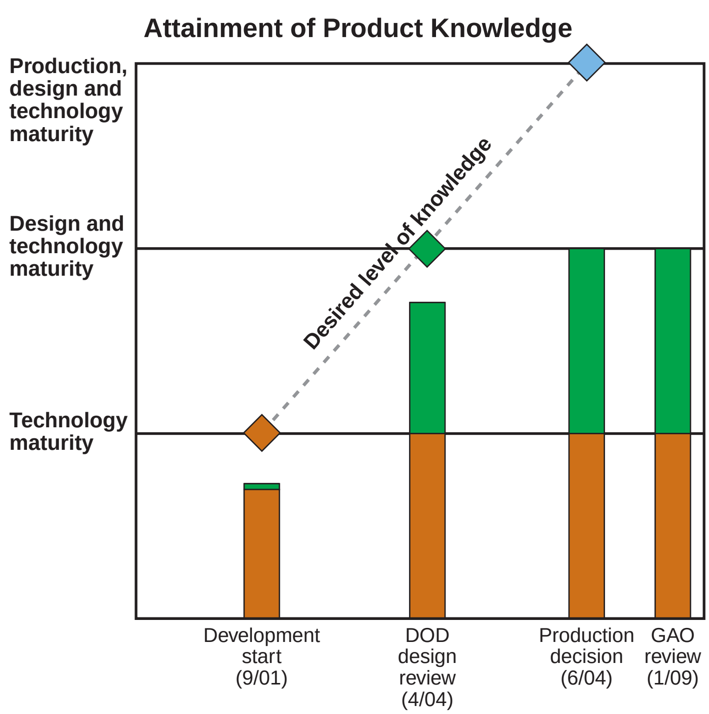
Program Essentials

Prime contractor: Lockheed Martin
Program office: El Segundo, CA
Funding needed to complete:
- R&D: $1,495.9 million
- Procurement: $2,313.4 million
- Total funding: $3,809.1 million
- Procurement quantity: 1

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2001	Latest 09/2008	Percent change
Research and development cost	$4,748.5	$7,205.4	51.7
Procurement cost	$1,404.4	$3,098.4	120.6
Total program cost	$6,152.9	$10,303.7	67.5
Program unit cost	$1,230.583	$2,575.932	109.3
Total quantities	5	4	-20.0
Acquisition cycle time (months)	111	170	53.2

The AEHF technologies are mature and the design appears stable. We could not assess production maturity because the program does not collect statistical process control data. In September 2008, the Air Force reported a critical Nunn-McCurdy unit cost breach due to cost growth brought on by technical issues, schedule delays, and increased costs for the procurement of a fourth AEHF satellite. For the second straight year, technical problems with satellite components resulted in a delay of the first launch. This latest delay is almost 2 years. Further, the program office estimates that the fourth AEHF satellite could cost more than twice the third satellite because some components that are no longer manufactured will have to be replaced and production will have to be restarted after a 4-year gap.



AEHF Program

Technology Maturity

According to the program office, all 14 AEHF critical technologies are mature, having been demonstrated in a relevant environment. All hardware has been integrated into the first satellite for system-level environmental testing.

Design Maturity

The AEHF's design appears stable with all of its expected design drawings released. However, in the last year, the program has discovered design problems with some components during testing. During system-level environmental testing of the first satellite, the program office identified six components with workmanship or design problems. Five of these components will need to be removed from the spacecraft for repair, and one will need a software fix. Once all components are repaired and reinstalled, the spacecraft will undergo environmental testing a second time to assure all components are working properly.

Continued problems with integration and testing have led to additional schedule delays. The launch of the first satellite has slipped almost two years—from November 2008 to as late as September 2010. The launch of the second satellite was delayed from August 2009 to around June 2011, and the third satellite is now planned for launch in 2012. Due to these delays, initial operational capability has slipped 3 years—from 2010 to 2013.

Production Maturity

We could not assess production maturity because the program office does not collect statistical process control data. However, prior to and during system-level environmental testing of the first satellite, the program identified workmanship problems at the component level, which have contributed to the program's schedule delays.

Other Program Issues

In September 2008, the Air Force reported a Nunn-McCurdy unit cost increase over the critical cost growth threshold. Program office officials stated the increased cost associated with the schedule delays, along with the much higher cost of the fourth satellite, increased average procurement unit cost about 130 percent above that of the previous acquisition program baseline.

The original AEHF program included the purchase of five satellites. In December 2002, satellites 4 and 5 were deleted from the program with the intention of using the first TSAT satellite to achieve full operational capability. However, because of concerns about TSAT development and a possible gap in capability, the conference report accompanying the fiscal year 2008 Defense Appropriations Act recommended funding for the advanced procurement of the fourth AEHF satellite and asked the Air Force to fully fund it in the fiscal year 2009 budget. The program office projects that the fourth satellite could cost more than twice the third satellite. Some electronics components on AEHF are no longer manufactured and integrating and testing new components will require additional time and money. Further, there will be a 4-year break in production, which the program office states will greatly add to the cost of the fourth satellite. The fourth satellite launch is planned for 2016.

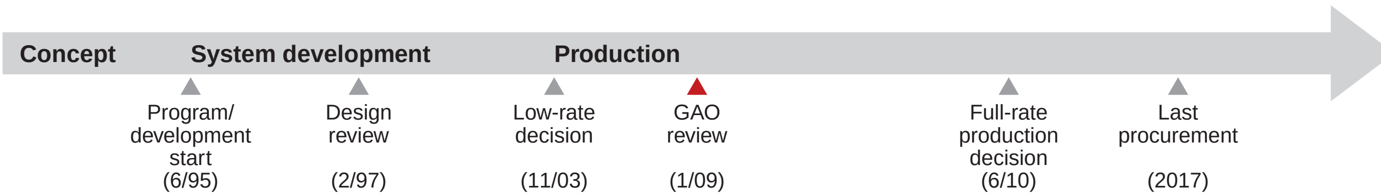
Agency Comments

In commenting on a draft of this assessment, the Air Force concurred with the information provided in this report.

Advanced Threat Infrared Countermeasure/Common Missile Warning System

The Army and Special Operations Command ATIRCM/CMWS is a component of the Suite of Integrated Infrared Countermeasures planned to defend U.S. aircraft from advanced infrared-guided missiles. The system will be employed on Army and Special Operations aircraft. ATIRCM/CMWS includes an active infrared jammer, missile warning system, and countermeasure dispenser capable of loading and employing expendables, such as flares and chaff.

Source: BAE Systems.



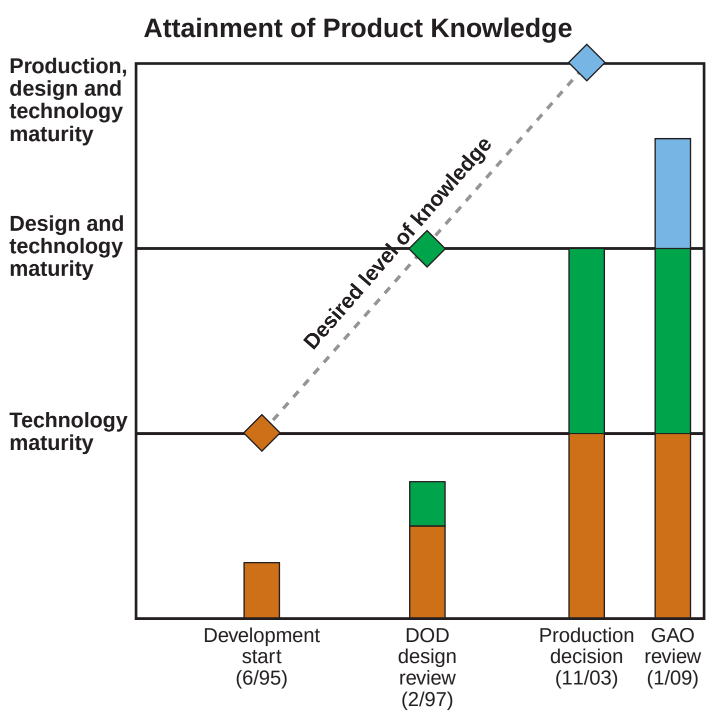
Program Essentials

Prime contractor: BAE Systems North America
Program office: Huntsville, AL
Funding needed to complete:
- R&D: $120.8 million
- Procurement: $1,966.4 million
- Total funding: $2,087.2 million
- Procurement quantity: 186

Program Performance (fiscal year 2009 dollars in millions)

	As of 03/1996	Latest 12/2007	Percent change
Research and development cost	$646.8	$810.5	25.3
Procurement cost	$2,649.3	$4,001.2	51.0
Total program cost	$3,296.1	$4,811.7	46.0
Program unit cost	$1.065	$1.341	25.8
Total quantities	3,094	3,589	16.0
Acquisition cycle time (months)	Classified	Classified	NA

The ATIRCM portion of the program is in low-rate production and the CMWS portion is in full-rate production. The technologies for CMWS are mature and the design is stable. Currently, the program's production processes are at various levels of control. The CMWS portion of the program entered limited production in February 2002 to meet urgent deployment requirements. However, full-rate production of the ATIRCM component was delayed because of reliability issues. Key technologies were demonstrated late in development, and only a small number of design drawings were completed by design review. Although the infrared jam head's reliability improved during recent testing, the Army plans to replace the current jam head turret with a smaller turret if a mature one is available.



ATIRCM/CMWS Program

Technology Maturity

All five critical technologies are now considered mature. Four of the critical technologies did not mature until after the design review in February 1997. The infrared jam head continued to have reliability issues after it matured. However, a reliability test was concluded in June 2008 and found the jam head had a significant improvement in reliability.

Design Maturity

The basic design of the system is complete, with all of the drawings released to manufacturing. However, the program office expects the number of drawings to change because the infrared jam laser and the infrared lamp will be replaced with a multi-band laser. Additionally, the CMWS electronic control unit is undergoing a product improvement, and the turret for the jam head is being replaced with a smaller and lighter weight turret. The number of drawings or potential changes will not be known until the changes are completed.

Production Maturity

According to program officials, the program has 17 key manufacturing processes in various phases of control. Also, the ATIRCM/CMWS acquisition strategy is currently being revised to upgrade and incorporate the technology improvements to the ATIRCM/CMWS. The critical manufacturing processes have not been completely assessed for the CMWS electronic control unit improvement, multiband laser, and the directed laser countermeasure jam head. Program officials further stated that as the design is finalized, the manufacturing processes will be assessed. Initial estimates are that 5 to 10 additional critical manufacturing processes will be identified at that time.

The Army entered limited CMWS production in February 2002 to meet an urgent need. Subsequently, full-rate production of the ATIRCM component was delayed because of reliability issues. The program implemented reliability fixes to six ATIRCM production representative subsystems for use in initial operational test and evaluation. The full-rate production decision for the complete system was delayed and is scheduled for June 2010.

Other Program Issues

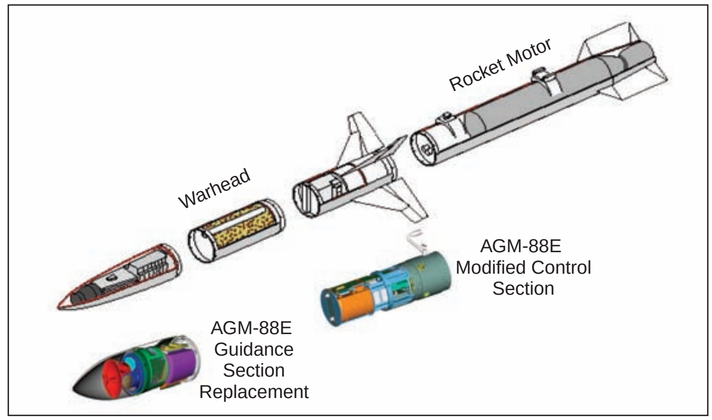
The Army uses the airframe as the acquisition quantity unit of measure even though it is not buying an ATIRCM/CMWS system for each aircraft. When the program began, plans called for putting an ATIRCM/CMWS on each aircraft. Due to funding constraints, the Army reduced the number of systems to be procured and will rotate the systems to aircraft as needed. The Army is buying kits for each aircraft, which include the modification hardware, wiring harness, and cables necessary to install and interface the ATIRCM/CMWS to each platform. Previously, the approved program was for 1,710 ATIRCMs; however, in May 2007, the Army reduced the number of ATIRCMs to 1,076 after a comprehensive requirements review. The current approved program is for 1,076 ATIRCMs, 1,710 CMWSs, and 3,571 kits to use for aircraft integration. The Army approved an ATIRCM Quick Reaction Capability (QRC) for the CH-47D/F helicopters in September 2008. The QRC is for 70 aircraft currently deployed in Iraq and Afghanistan. The QRC is being funded with supplemental appropriations and its cost is not included in the current cost estimate.

Program Office Comments

Program officials stated that all aircraft designated for Iraq and Afghanistan have been equipped with CMWS. In addition, the program office is in the process of equipping all aircraft with a fifth sensor and has received a requirement to equip OH-58D helicopters with CMWS. The Army is continuing ongoing efforts to improve CMWS performance to improve detection while reducing false alarm rates. Further, the program office has embarked on a QRC effort to equip all CH-47 helicopters in Iraq and Afghanistan with ATIRCM. Finally, the program office plans to incorporate a small, light-weight low-cost turret into ATIRCM to provide a fleet-wide infrared countermeasure capability. The program office also provided technical comments on a draft of this assessment, which we incorporated as appropriate.

AGM-88E Advanced Anti-Radiation Guide Missile (AARGM)

The Navy's AARGM is an air-to-ground missile for carrier-based aircraft designed to destroy enemy radio frequency-enabled surface-to-air defenses. The AARGM is an upgrade to the AGM-88 High Speed Anti-Radiation Missile (HARM). It will utilize the existing HARM propulsion and warhead sections, a modified control section, and a new guidance section with a Global Positioning System and improved targeting capabilities. The program is following a phased approach for development. We assessed Phase I and made observations on Phases II and III.



Source: AGM-88E AARGM Program Office (PMA).

Concept | **System development** | **Production**

- Development start (6/03)
- Design review (3/06)
- Low-rate decision (9/08)
- GAO review (1/09)
- Full-rate decision (2/10)
- Initial capability (9/10)

Program Essentials

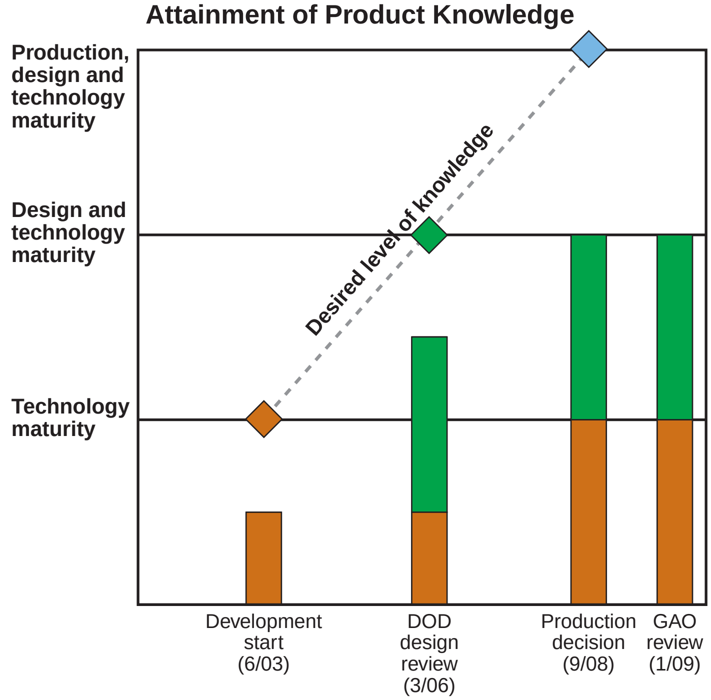
Prime contractor: ATK Missile Systems Company
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $13.2 million
Procurement: $949.2 million
Total funding: $962.4 million
Procurement quantity: 1,842

Program Performance (fiscal year 2009 dollars in millions)

	As of 07/2003	Latest 12/2007	Percent change
Research and development cost	$615.4	$653.2	6.2
Procurement cost	$930.6	$992.0	6.6
Total program cost	$1,546.0	$1,645.3	6.4
Program unit cost	$.864	$.861	-0.3
Total quantities	1,790	1,911	6.8
Acquisition cycle time (months)	85	87	2.4

The AARGM program received approval to enter into production after conducting a successful production readiness review and operational assessment. The AARGM's production processes are not currently considered mature because the contractor will not start collecting statistical process control data until low-rate production begins. Instead, the contractor demonstrated that the overall AARGM round was mature enough to enter production using manufacturing readiness levels. The AARGM's critical technologies are mature and its design is stable. The AARGM's critical technologies were nearing maturity at development start because the major subsystems on the program were designed, developed, and flight tested as part of an advanced technology demonstration program. The program will face a funding shortfall if developmental testing is not completed by March 2009 as planned.

Attainment of Product Knowledge



AGM-88E AARGM Program

Technology Maturity

Both of the AARGM's critical technologies—the millimeter wave software and radome—are currently mature and completing developmental testing. The two technologies were nearing maturity at the start of development because the program designed, developed, and flight tested them under two prior advanced technology demonstration programs. This is a good practice for maturing technologies prior to their inclusion in acquisition programs.

In addition to the two critical technologies identified in the program's most recent technology readiness assessment, the program office assessed three other technologies—a GPS-aided inertial navigation system (INS), weapons impact assessment (WIA) transmitter, and integrated broadcast service (IBS) receiver—in its production requirements document. The program stated that the GPS-aided INS and WIA transmitter were mature at production start and that the IBS receiver was nearing maturity. However, program officials stated that the IBS receiver, which can receive targeting information from sources other than the aircraft prior to launch, does not pose a risk for the current program because it is planned for inclusion in a later phase and does not affect the AARGM's ability to meet its key performance parameters.

Design Maturity

The design of the AARGM is currently stable and all of the drawings were released to manufacturing by the start of production. The AARGM's design has been stable since its March 2006 design review and the number of drawings has grown only marginally. In addition, software development is nearing completion. Of the 91 planned software blocks, 86 had been completed at the start of production, and 95 percent of the total lines of code had been released. The AARGM program has also demonstrated in an operational assessment that the design can perform as expected. In addition, most of the AARGM elements included in the prototype used in this operational assessment were production representative.

Production Maturity

The AARGM's production processes are not currently considered mature because, according to the program office, the contractor will not start collecting statistical process control data until low-rate production begins. However, the program has identified the number of critical manfucturing processes, and the contractor plans to demonstrate that 90 percent are mature using statistical process control data during low-rate initial production. According to program officials, the contractor conducted its own assessment to support the program's production decision and demonstrated that the overall AARGM round was mature enough to enter production using manufacturing readiness levels. The contractor identified several management risks and challenges associated with the cost of several components and subsystems and the millimeter wave technology.

Other Program Issues

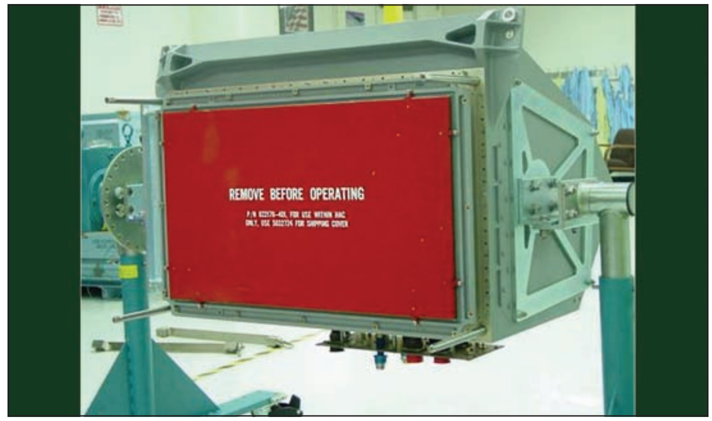
The AARGM program could face funding shortfalls if the contractor cannot complete developmental testing by March 2009. According to a program official, the program will need to seek additional funding if developmental testing is not completed by this date. The program received approximately $20.3 million less than was requested for fiscal year 2009. According to the program office, the reduction in funding could have caused a break in initial production. To prevent this, the AARGM program will have three lots during initial production instead of two, and will delay the award of the full-rate production contract from fiscal year 2010 to 2011.

Program Office Comments

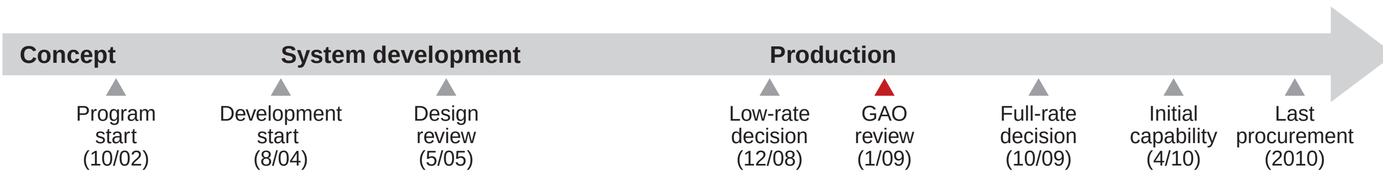
The program office states that the contractor has submitted an acceptable plan for completing developmental testing by the spring of 2009, which mitigates the magnitude of system development and demonstration funding shortfalls, and the program office is addressing funding requirements. The program recently received approval to enter into low-rate initial production. Program officials further noted that the program office has established a production plan that maintains initial operational capability and assures transition from low-rate initial production to full-rate production without a production break. The initial production contract is on track for award by the end of the first quarter of fiscal year 2009.

B-2 Radar Modernization Program (B-2 RMP)

The Air Force's B-2 RMP is designed to modify the current radar system to resolve potential conflicts in frequency band usage. Program officials told us that to comply with federal requirements, the frequency must be changed to a band where DOD has been designated as the primary user. The modified radar system, with both conventional and nuclear operational modes, is being designed to support the B-2 stealth bomber and its combination of stealth, range, payload, and near-precision weapons delivery capabilities.



Source: Raytheon.



Program Essentials

Prime contractor: Northrop Grumman
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $99.1 million
- Procurement: $372.7 million
- Total funding: $471.8 million
- Procurement quantity: 13

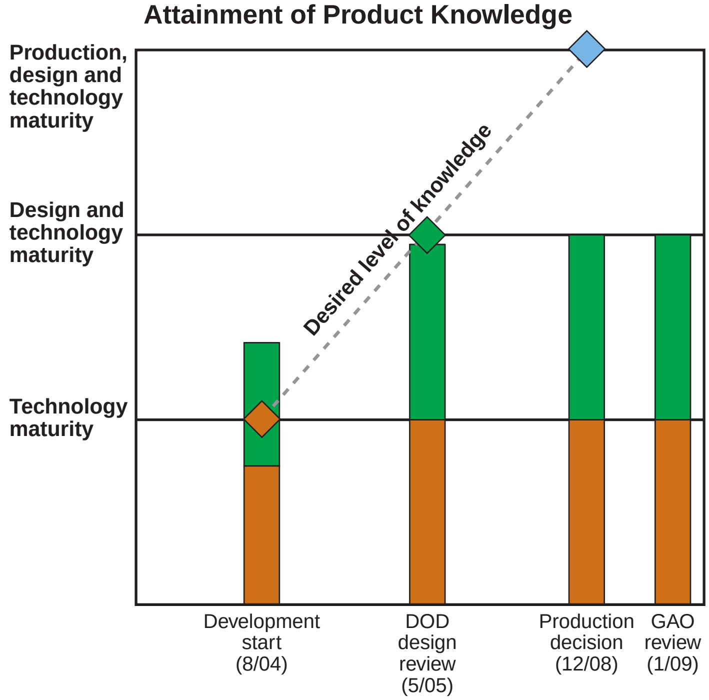
Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2004	Latest 08/2008	Percent change
Research and development cost	$729.0	$707.9	-2.9
Procurement cost	$570.2	$529.5	-7.1
Total program cost	$1,299.2	$1,237.4	-4.8
Program unit cost	$61.869	$61.868	-0.0
Total quantities	21	20	-4.8
Acquisition cycle time (months)	63	68	7.9

The total quantity of 20 operational units includes 13 to be bought with procurement funds and 7 with research and development funds. Costs reflect the program of record but are expected to change.

The four B-2 RMP critical technologies are currently considered mature and the program has released 100 percent of its design drawings. However, in early 2007, the program experienced technical problems with the radar antenna. Due to an aggressive development schedule, important systems engineering and integration tasks were not completed, and subsequent antenna performance deficiencies forced a delay in the development program, including flight-testing, in January 2007. Consequently, the Air Force reprogrammed fiscal year 2007 procurement funds to other priorities, and the fiscal year 2008 Defense Appropriation Act conference report suggested a reduction in the RMP's procurement funding. The Air Force plan is to enter low-rate production before the planned completion of some events such as development flight-testing, follow-on operational testing, and an assessment of radar reliability.

Attainment of Product Knowledge



B-2 RMP Program

Technology Maturity

All four of the B-2 RMP's critical technologies are currently mature. However, in early 2007, the program experienced technical problems including numerous system failures and misrepresentations of radar-displayed weather. These difficulties contributed to a halt in the flight-test program and a delay in the start of production. The program reviewed the technical problems and systems engineering process, determined the root causes of the problems, and resumed flight-testing in June 2007.

Design Maturity

Eighty-five percent of the expected drawings were released to manufacturing at the program design readiness review in May 2005. Since then, all drawings have been released.

Production Maturity

The program does not collect statistical process control data to assess production maturity because of the small number of production units. However, it has taken steps to understand and demonstrate production maturity. Six development radar units have been produced using production processes, tooling, and labor.

Other Program Issues

In late January 2007, the development program, including flight-testing, was delayed, and the Air Force began replanning the program because of radar antenna performance problems. The Air Force reprogrammed fiscal year 2007 funds for the first four production radar units and the fiscal year 2008 Defense Appropriation Act conference report suggested a reduction in the RMP's procurement funding. Program officials acknowledged that pursuing an aggressive schedule to meet the mandated change in radar frequency caused significant program execution problems. A highly concurrent development and production program was put in place, and important systems engineering, integration and testing tasks were not completed. Because the program did not complete these tasks, it had difficulty understanding the causes of the radar antenna's technical problems when they were encountered during flight-testing. The Air Force eventually identified the root causes of the radar antenna technical problems and flight-testing resumed in June 2007. In fiscal year 2008, the program received limited funding for advance procurement items for six radar ship sets in preparation for entering low-rate production. Production contract costs are currently being determined but could potentially be about 14 percent over the current program baseline.

The Air Force entered low-rate initial production in December 2008. While operational testing of the radar's conventional capability was completed in December 2008, the results of follow-on operational testing of the radar's nuclear capability will not be available until December 2009. Some limited issues with the radar's performance still exist. An operational assessment issued in August 2008 revealed the radar is having some minor difficulty with weather characterization, which is planned to be addressed with a software fix. Development flight-testing has also shown that the overall radar's reliability falls short of stated requirements, even though the majority of the reliability issues are with legacy, not modernization, aspects of the radar. Operational testing officials indicate that reliability improvements must occur to demonstrate system maturity. A full reliability assessment is planned for completion in 2010, after the planned full-rate production decision.

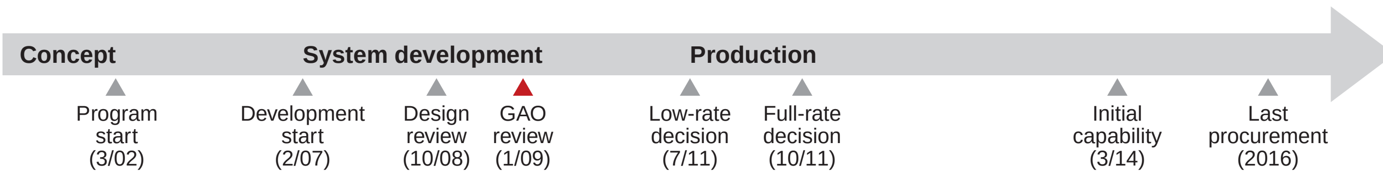
Program Office Comments

The program office agrees with the accuracy of this report, based on the reported results of the operational assessment. However, the data supporting the operational assessment are based on only 67 hours of flight-testing that occurred through mid-January 2008. Since that time, more than 200 hours of additional flight-testing has been accomplished to rectify and verify identified system performance issues and there have been multiple software and firmware updates. While additional software development and performance verification remains, testing to date, including completion of all hardware qualification testing, supports the Air Force assertion of high confidence that the hardware design is stable and ready for production. Current flight-test data and analysis also support the Air Force assessment that this hardware will meet or exceed reliability requirements. Final reliability will be assessed at the end of development using all available operational data.

B-2 Spirit Advanced Extremely High Frequency (EHF) SATCOM Capability

The Air Force's B-2 EHF SATCOM is a satellite communication system designed to upgrade the B-2's avionics infrastructure, replace the ultra high frequency system, and ensure secure, survivable communication capability while maintaining its low-observable signature. The program has three increments: Increment 1 includes upgraded flight management computer processors; Increment 2 adds antennas and radomes; and Increment 3 allows connectivity to the Global Information Grid. We assessed Increment 1 and made observations on Increments 2 and 3.

Source: B-2 Systems Group 1999, USAF photo.



Program Essentials

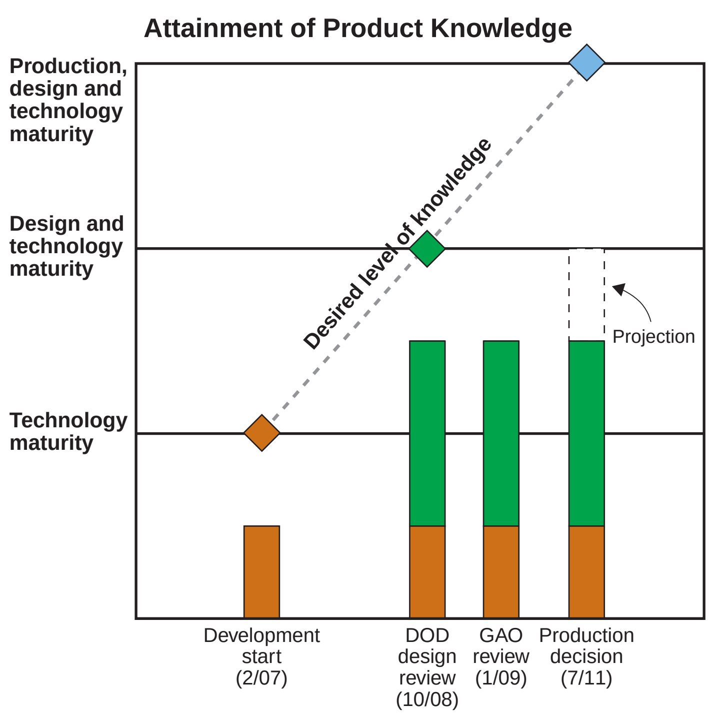
Prime contractor: Northrop Grumman
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $372.4 million
- Procurement: $119.7 million
- Total funding: $492.1 million
- Procurement quantity: 16

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2007	Latest 08/2008	Percent change
Research and development cost	$566.3	$575.7	1.7
Procurement cost	$119.3	$119.7	0.3
Total program cost	$685.6	$695.4	1.4
Program unit cost	$32.649	$34.770	6.5
Total quantities	21	20	-4.8
Acquisition cycle time (months)	85	85	0.0

Cost and schedule data above is for Increment 1 only.

All Increment 1 critical technologies are nearing maturity and the design appears stable. However, since the critical technologies will not be fully mature until after the design review, additional design changes could be necessary. During the past year, the EHF program revised the software plan to better align requirements with system design. A program official acknowledged the potential for cost overruns from this effort, but anticipated being able to cover overruns with current funding. While software development is meeting the new schedule, the program is still at risk for schedule delays because the most difficult software work remains to be done. Increments 2 and 3 are not yet in development, but there are already areas of concern. For instance, critical technologies for Increment 2 are very immature, will add significant weight, and may affect the aircraft's low observable nature.



B-2 EHF SATCOM Inc 1 Program

Technology Maturity

The B-2 EHF SATCOM program, Increment 1, entered system development in February 2007 with all five of its critical technologies approaching maturity. However, the program office does not expect the technologies to be demonstrated in a realistic environment, and therefore fully mature, until after the design review in October 2008. The program office is projecting that the technologies will be flight qualified by the production decision in 2011.

Design Maturity

The design for Increment 1 of the B-2 EHF SATCOM program appears stable. The program completed its design review in October 2008, with 90 percent of its drawings released. All drawings are expected to be released by December 2008; however, since the critical technologies are not yet fully mature, additional design changes could be necessary.

During the past year, officials revised the software plan in an attempt to better align requirements with the system design. The revision was needed because, according to one program official, phasing of the work was not done well initially and requirements for all software blocks were not defined up front. As a result of these changes, requirements for all software components must be defined before coding begins. Although program officials said software development is currently meeting the new schedule, two future software blocks (blocks 7 and 8, out of 10 planned) will be the most challenging and pose a potential schedule risk for the program. Also, a program official said the software plan could result in additional costs, but that there should be sufficient funds in the program to cover overruns.

Other Program Issues

In October 2008, the B-2 program office said the estimated program cost for all increments was more than $2.3 billion. While Increments 2 and 3 are not yet in development, the program office has already identified areas of concern. The program office expects Increment 2 to be the most extensive modification to the B-2 platform since it left production. The two most critical technologies for Increment 2, the radomes and antennas, are very immature. These components and their associated hardware will add significant weight to the platform. Moreover, since their integration requires holes to be cut in the aircraft skin, the low observable properties of the aircraft could be affected. Increment 2 is scheduled to enter development in February 2011. Additionally, Increment 3 requirements are not yet defined or funded, and its four critical technologies are immature.

In March 2008, the B-2 EHF SATCOM program initiated a $38.1 million advanced development effort for Increment 2 to better define system requirements and address potential risks. As part of that effort, the program conducted loads analyses for the antenna hardware. Based on the results, the program decided to make structural modifications to B-2 aircraft to ease installation by providing a uniform mounting system. Likewise, working prototypes of the antenna positioning system and the radome, which houses the antenna, have been developed and are being tested. The program also plans to cut holes in a static test article in late 2009 to identify potential radome installation issues before cutting into an actual B-2 aircraft.

Last year, we noted that the B-2 EHF SATCOM program was dependent on the Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program, which was experiencing significant delays. According to program officials, the B-2 EHF SATCOM program will attempt to mitigate schedule risk by performing software and hardware integration activities with the FAB-T program; however, FAB-T terminals are still required as Government Furnished Property.

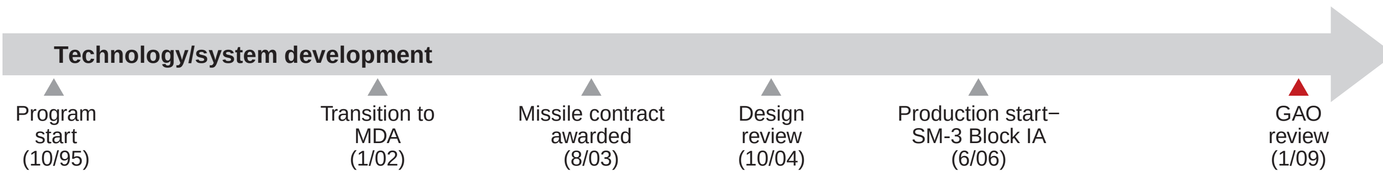
Agency Comments

The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

BMDS Aegis Ballistic Missile Defense (Aegis BMD)

MDA's Aegis BMD element is a sea-based missile defense system being developed in incremental, capability-based blocks to defend against ballistic missiles of all ranges. Key components include the shipboard SPY-1 radar, Standard Missile 3 (SM-3) missiles, and command and control systems. It will also be used as a forward-deployed sensor for surveillance and tracking of ballistic missiles. The SM-3 missile has multiple versions in development or production: Blocks IA, IB, and IIA. We assessed the SM-3 Block IA.

Source: Aegis BMD Program Office.



Program Essentials

Prime contractor: Lockheed Martin (WS), Raytheon (SM-3)
Program office: Dahlgren, VA
Funding FY09-FY13:
R&D: $5,093.2 million
Procurement: NA
Total funding: $5,093.2 million
Procurement quantity: NA

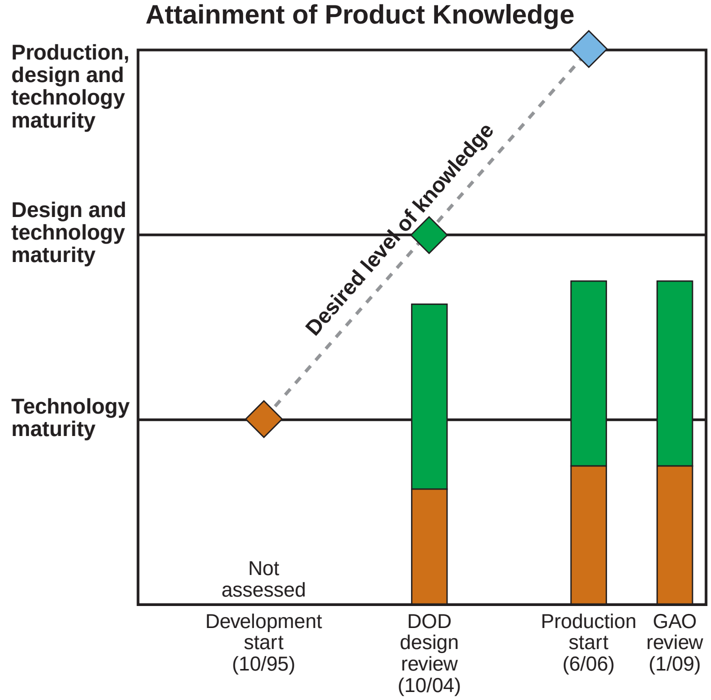
Program Performance (fiscal year 2009 dollars in millions)

	As of 07/2007	Latest 02/2008	Percent change
Research and development cost	$11,457.7	$11,291.5	-1.5
Procurement cost	NA	NA	NA
Total program cost	$11,457.7	$11,291.5	-1.4
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013. Latest totals do not include sustainment funds for fielded assets.

Program officials assess all four Block IA critical technologies as fully mature; however, the Solid Divert and Attitude Control System (SDACS) and the zero pulse mode of the missile's third stage rocket motor should not be considered fully mature since neither has been demonstrated in a realistic environment. The program reported that the missile's design is stable with 100 percent of drawings released to manufacturing. We could not assess the production maturity of Block IA missiles because, according to program officials, the contractor's processes are not mature enough to collect statistical control data. Instead, the program uses other means to gauge production readiness, such as tracking rework hours and cost of defects per unit.The program will buy 23 more Block IA missiles than planned because it extended the development of Block IB by 1 year.

Attainment of Product Knowledge



Aegis BMD Program

Aegis BMD Element - Block 2004

Aegis program officials consider all four critical technologies for the SM-3 Block IA missile to be mature. However, we assessed two technologies—pulse two of the Solid Divert and Attitude Control System (SDACS) and the zero pulse mode of the Third Stage Rocket Motor (TSRM)—as nearing maturity. The other two technologies—the kinetic warhead seeker and the SDACS pulse one—are fully mature and have been successfully demonstrated during operational testing. Although pulse two is identical in technology and functionality as pulse one, pulse two has not been flight tested and cannot be considered fully mature. Program officials state that both pulse modes have been successfully tested in four consecutive ground tests, but that it is difficult for the SDACS to use both pulse modes in a flight test because the first pulse has provided sufficient divert capability to make the intercept. Similarly, the zero pulse mode of the TSRM that increases the missile's capability against shorter-range threats has not been flight tested. According to the program, range safety limitations continue to preclude Aegis testing of the zero pulse mode. Officials from the Director, Operational Test and Evaluation state that operational testing for these two critical technologies is still an outstanding recommendation that the program has yet to address.

Design Maturity

Program officials reported that the design for the SM-3 Block IA missiles being produced is stable, with 100 percent of its drawings released to manufacturing. Program officials do not anticipate additional design changes. However, Aegis officials told us the TSRM had experienced a malfunction, which required the nozzles to be redesigned. The program has no plans to retrofit the SM-3 Block I missiles that have already been manufactured because their service life expires in 2009.

Production Maturity

We could not assess the production maturity of the SM-3 Block IA missiles because, according to program officials, the contractor's production processes are not yet mature enough to collect statistical control data. The Aegis BMD program continues to use other means to assess progress in production and manufacturing, such as tracking rework hours, cost of defects per unit, and other defect and test data.

Other Program Issues

Aegis encountered problems in development, testing, and transition to production of the SM-3 Block IA missile. As a result, MDA officials extended the development of the follow-on Block IB missile by 1 year, delaying its procurement by 1 year as well. The 1 year development extension caused a future missile buy to change from an SM-3 Block IB configuration to Block IA. MDA will buy 23 more Block IA missiles than originally planned.   MDA plans to buy 82 SM-3 Block IA missiles by fiscal year 2011. Finally, the program had a goal to deliver 20 Block IAs by the end of fiscal year 2008, which was met ahead of schedule.

The Block IB is planned to provide more capability than the Block IA. The Aegis program is developing new technologies for Block IB that would provide a two-color seeker capability for better target discrimination and an adjustable divert and attitude control system.

Block IIA critical design review, under a cooperative agreement with the government of Japan, has been delayed more than 1 year. Block IIA design collaboration on the TSRM has taken longer than Aegis officials expected because U.S. and Japanese engineers followed different approaches during the design phase. The Block IIA missile is intended to be faster and have an advanced discrimination seeker. The first operational test of the Block IIA is planned for July 2014.

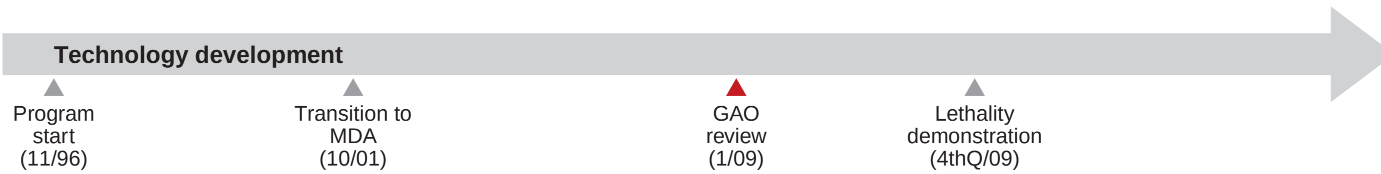
Program Office Comments

Technical comments provided by the program office were incorporated as appropriate. In addition, program officials acknowledged that the zero-pulse mode of the TSRM is yet untested, but consider overall system performance as more than satisfactory. Because of test range safety constraints, officials stated that it is unclear when that testing will occur.

BMDS Airborne Laser (ABL)

MDA's ABL element is being developed to destroy enemy missiles during the boost phase of their flight. Carried aboard a modified Boeing 747 aircraft, ABL employs a battle management subsystem to plan and execute engagements, a high-energy chemical laser to rupture the fuel tanks of enemy missiles, and a beam control/fire control subsystem to focus the high-energy chemical laser beam. We assessed the system's prototype design that is expected to lead to a lethality demonstration in 2009.

Source: Airborne Laser Program Office.



Program Essentials

Prime contractor: Boeing
Program office: Kirtland AFB, NM
Funding FY09-FY13:
R&D: $3,040.3 million
Procurement: NA
Total funding: $3,040.3 million
Procurement quantity: NA

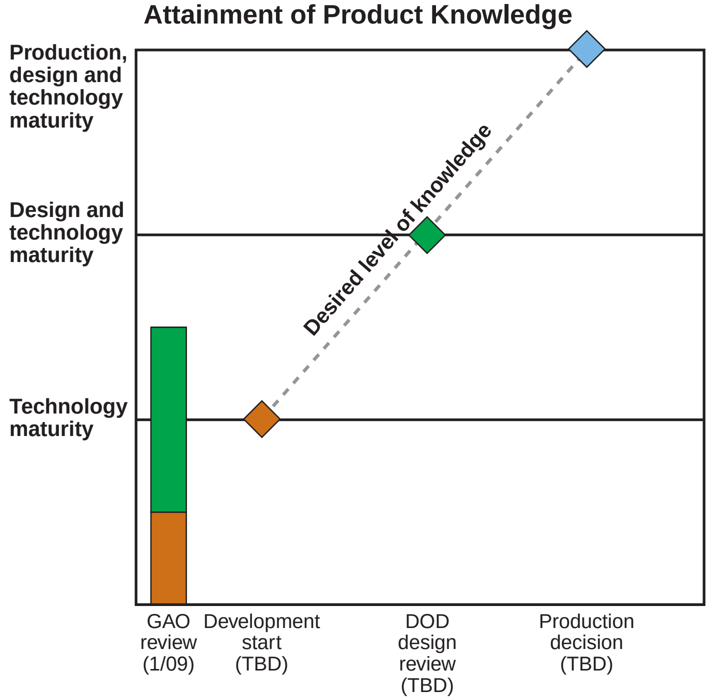
Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2007	Latest 07/2008	Percent change
Research and development cost	$8,289.9	$8,213.7	-0.9
Procurement cost	NA	NA	NA
Total program cost	$8,289.9	$8,213.7	-0.9
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013.

None of ABL's seven critical technologies are fully mature. Program officials plan to demonstrate the prototype's critical technologies during a flight test planned for the fourth quarter of fiscal year 2009. Even if the prototype's technologies are demonstrated, the program must make the business case that the system is affordable and operationally feasible—a task that has not yet been accomplished. The program has released 100 percent of the prototype's design drawings; however, additional drawings or design changes may be needed to address any problems encountered during testing. Transitioning to an operational aircraft could also require additional design work. During fiscal year 2008, the program encountered technical problems with the system's beam control/fire control which contributed to unanticipated increases in the contractor's cost and schedule budgets for the year.

Attainment of Product Knowledge



ABL Program

Technology Maturity

None of ABL's seven critical technologies are fully mature. Program officials assessed one of ABL's seven critical technologies—managing the high-power beam—as fully mature, but the technology has not been demonstrated in a realistic environment. The remaining six technologies—the six-module laser, missile tracking, atmospheric compensation, transmissive optics, optical coatings, and jitter control—were assessed as nearly mature. The program plans to demonstrate all of its critical technologies during flight testing leading up to a lethality demonstration of the system prototype, which is scheduled for 2009. During the demonstration, the ABL will attempt to shoot down a ballistic missile.

Although program officials assessed jitter control as nearly mature, they continue to consider this technology as a high risk to the program. Jitter is a phenomenon pertaining to the technology of controlling and stabilizing the high-energy laser beam so that vibration unique to the aircraft does not degrade the laser's aimpoint. It is critical to imparting sufficient energy on the target to rupture its fuel tank. Jitter mitigation is important to the success of the ABL because if it is not controlled, the ABL may not be able to succeed in demonstrating lethality. Program officials assert that jitter performance measured during testing was determined to be sufficient to support a successful lethal demonstration. Officials also noted that they are pursuing jitter mitigations to provide additional margin for the lethality demonstration in 2009. However, it should be noted that jitter will have to be substantially reduced for the operational system.

Design Maturity

We did not assess ABL's design stability because its initial capability will not be fully developed until the second aircraft is well underway. While the program has released 100 percent of its engineering drawings for the prototype, it is unclear whether the design of the prototype aircraft can be relied upon as a good indicator of design stability for the operational aircraft. More drawings may be needed if the design is enhanced or if problems encountered during flight testing force design changes.

Other Program Issues

During fiscal year 2008, the program's prime contractor continued to experience negative cost and schedule trends. The program incurred unanticipated costs and required additional time to rectify technical issues with the ABL's beam control/fire control hardware, including approximately a one-month delay to integration and test activities to replace and refurbish key components of the beam control/fire control subsystem. However, the contractor believes it can recover the schedule in time to conduct the lethality demonstration as planned in 2009.

The 2009 lethality demonstration is a key knowledge point for MDA. Upon completion of the demonstration, the agency will decide the future of the program. If the demonstration is successful, the agency will analyze whether to invest in a second aircraft—the aircraft in which an initial capability will reside. However, even with the successful completion of the lethality demonstration, MDA will need to determine whether an operationally effective and suitable ABL system can be developed with available technologies, funding, time, and management capacity. For example, the ABL will require unique support in addition to the standard support required for the aircraft. To remain deployed for extended periods of time, ABL will need a facility in the theater of operations that can store and mix chemicals for the high-energy laser. ABL will also require a ground support cadre and transportation of chemicals to a forward location. These support requirements and the costs associated with them have yet to be fully determined by MDA.

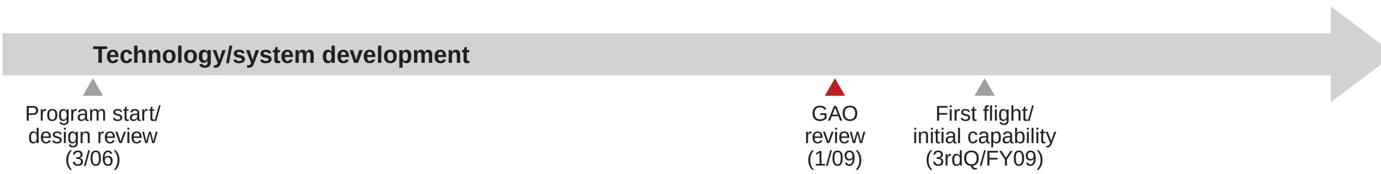
Program Office Comments

The program office provided technical comments, which were incorporated as appropriate. Program officials also stated that they have made tremendous progress, and a series of tests will build confidence leading up to the lethal demonstration. They stated that those tests will also prove risk mitigation efforts, like jitter control, have been successful. They acknowledged that significant work remains but assert that analysis indicates the program will provide an effective operational capability. They also stated that after successful demonstration they will transition to a production representative program. They further noted that they are using current program data to develop a plan that is affordable, operationally effective, and supportable.

BMDS Flexible Target Family (FTF)

MDA's Flexible Target Family is a new family of short, medium, and long-range targets designed with common components for ground, air, and sea launch capabilities. These targets were being developed to eventually replace target system designs currently used to test elements of the Ballistic Missile Defense System (BMDS). MDA recently stopped working on all FTF variants except the 72-inch LV-2 ground-launched target. We assessed this missile.

Source: Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin
Program office: Huntsville, AL
Funding FY09-FY13:
- R&D: $1,322.4 million
- Procurement: NA
- Total funding: $1,322.4 million
- Procurement quantity: NA

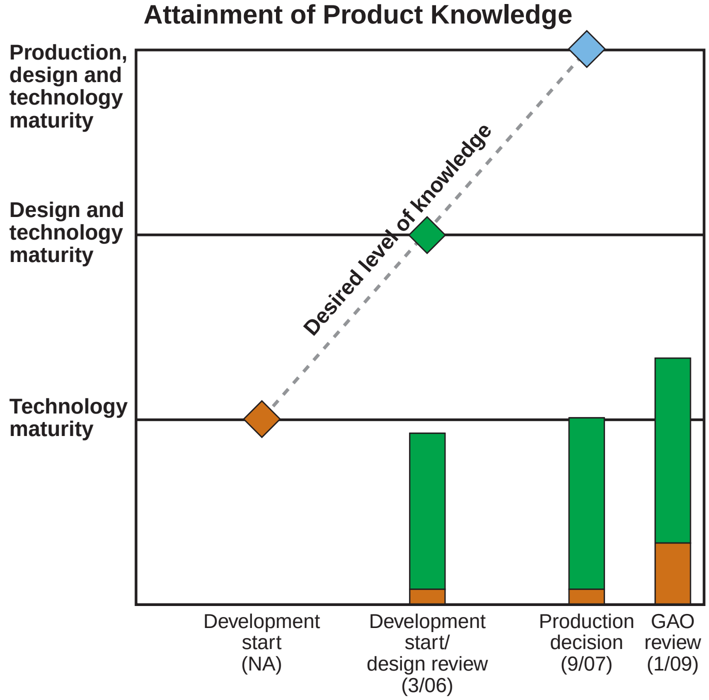
Program Performance (fiscal year 2009 dollars in millions)

	As of 03/2006	Latest 09/2008	Percent change
Research and development cost	NA	$1,418.1	NA
Procurement cost	NA	NA	NA
Total program cost	NA	$1,418.1	NA
Program unit cost	NA	$59.088	NA
Total quantities	NA	24	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from fiscal years 2008 to 2013.

Four of the LV-2 target's six critical technologies are nearing maturity; two are immature. The LV-2's design appears stable, but ongoing technology maturation efforts could lead to design changes. Program office officials expect all critical technologies to be mature before MDA uses the first LV-2 in a planned third quarter, fiscal year 2009, flight test; however, two of these technologies will not be flight tested before that time. While most of the missile's components have been flown in legacy systems, many have been modified for the LV-2 and have not been flown together. Using a BMDS element flight test as "first flight" for a target missile poses significant risk for MDA. The qualification process for the LV-2 was more difficult and costly than expected. Development and production costs for the first four targets have grown 34 percent and development is still not complete.

Attainment of Product Knowledge



FTF Program

Technology Maturity

None of the LV-2's six critical technologies are mature, even though the missile is currently in production. Four of the technologies are nearing maturity and two are still immature. The LV-2 target began development in March 2006 with almost all of its technologies still being demonstrated in a lab or through analytical studies—a low level of maturity. The program office estimates that all six critical technologies will be mature before they are needed for BMDS flight tests in fiscal year 2009. However, the components will not be flight tested in a relevant environment prior to these tests, posing significant risk for MDA's flight test program.

Two of the LV-2's critical technologies—the reentry vehicle separation system and countermeasure integration—are components of a payload deployment module that have been designed and built specifically for the LV-2 and have not been flight tested. The other four technologies—the re-entry vehicle shroud, avionics suite, avionics software, and the C4 booster—are components that have been previously flown on legacy systems, but their form, fit, and function have been modified for the LV-2 design. The reentry vehicle shroud is the least mature and may need to be redesigned before it can be used in the third LV-2 flight test, planned for fourth quarter fiscal year 2009. As a risk mitigation step, the program office is developing a backup technology, but it is very immature and the program would need additional funding to complete the development effort.

Design Stability

The design of the LV-2 target appears stable, although the target lacks the technology maturity and flight test history to show this design can operate as intended. While the program office has now released 92 percent of engineering drawings to manufacturing, ongoing efforts to test critical technologies in a realistic environment—in-flight—may lead to additional modifications to the target's design. The program office estimates that 91 percent of engineering drawings were complete when they started producing the first LV-2 target missile in September 2007, however the total expected number of drawings has since grown. In addition, 83 percent of the design drawings have required changes after they were released.

Production Maturity

We could not assess production maturity because the program office does not have statistical process control data on the LV-2 target's critical manufacturing processes. The LV-2 is the first target in the Flexible Target Family to be produced. At this time, the program relies on its contractor's quality system to verify product integrity and to identify production trends. The program has initially contracted to buy four vehicles, but future plans call for four to six vehicles per year.

Other Program Issues

Development of the LV-2 target has been more difficult and more costly than expected. Some of the missile's components failed to complete the qualification process and are being redesigned. These development problems have delayed the first launch of the LV-2 target from fourth quarter, fiscal year 2008 to third quarter, fiscal year 2009. The development and production costs of the first four targets have grown 34 percent, from $245 million to at least $328 million, and development is still not complete. In addition, integration and launch options were subsequently added to the contract, bringing the cost up to $405 million.

Program Office Comments

Program officials stated that GAO's knowledge build graph depicts a very limited level of product knowledge for a program near completion of the first four flight units. Officials stated that the first FTF 72-inch target flight in third quarter, fiscal year 2009, will lift the rating on four of six critical technologies to mature (avionics suite, avionics software, C4 booster, and reentry vehicle separation system). The remaining critical technologies (reentry vehicle shroud and payload deployment module) will be proven on following flight tests.

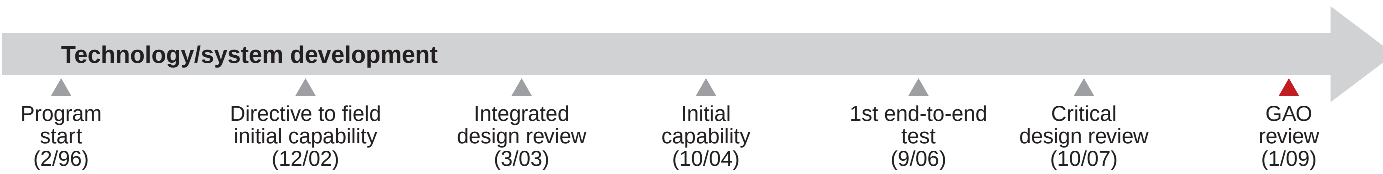
GAO Response

The knowledge build graph accurately shows the current and historical state of the program. Technologies are not mature until they are proven in flight and MDA has not yet launched the 72-inch LV-2 target. MDA made the decision to begin developing and producing the target when critical technologies were still immature. Our assessment and the graph depict the challenges and increased risk associated with this decision.

BMDS Ground-Based Midcourse Defense (GMD)

MDA's GMD is being fielded to defend against limited long-range ballistic missile attacks during the midcourse phase of flight. The new block structure develops blocks of capability concurrently, and GMD supports multiple blocks in the Ballistic Missile Defense System. It consists of an interceptor and a fire control system that formulates battle plans and directs components and is integrated with BMDS radars. We assessed the maturity of all technologies, but design and production maturity only for the interceptor's current configuration.

Source: Department of Defense.



Program Essentials

Prime contractor: Boeing Company
Program office: Huntsville, AL
Funding FY09-FY13:
R&D: $5,485.8 million
Procurement: NA
Total funding: $6,311.5 million
Procurement quantity: NA

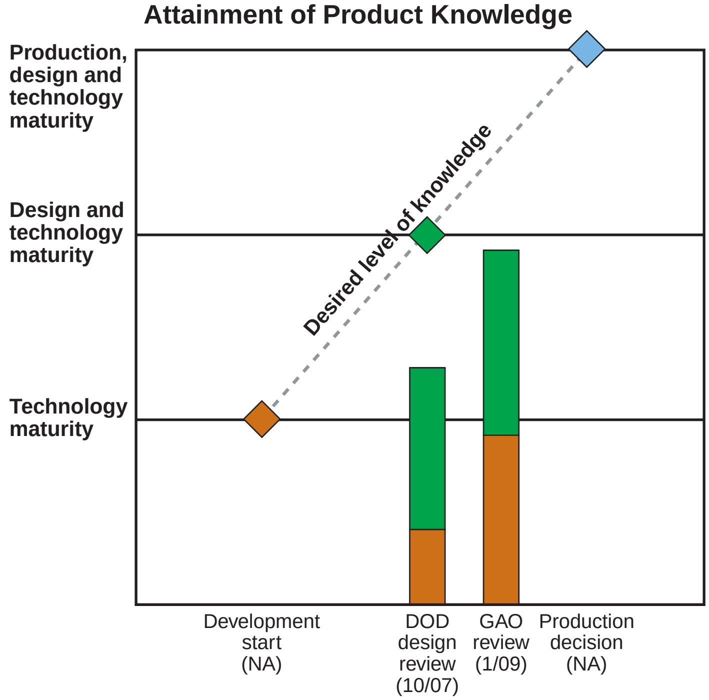
Program Performance (fiscal year 2009 dollars in millions)

	As of 03/2001	Latest 08/2008	Percent change
Research and development cost	NA	$35,533.1	NA
Procurement cost	NA	NA	NA
Total program cost	NA	$35,533.1	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013. Totals include program office designated military construction funding but not sustainment costs.

All technologies critical to the fielded GMD configuration are mature, but two technologies in the upgraded interceptor are experiencing problems in development. All drawings for the current interceptor have been released to manufacturing; however, the number of drawings may increase in response to an expansion of planned refurbishment activities and issues discovered during flight testing. MDA is producing hardware for operational use, but does not intend to make a formal production decision. In fact, MDA has bought interceptors before the critical technologies planned for that configuration had been demonstrated in a realistic environment. Since 2005, GMD has only conducted three intercept flight tests, which limits the capability to assess the system's overall performance.

Attainment of Product Knowledge



GMD Program

Technology Maturity

All nine technologies in the fielded configuration are mature, but two technologies being developed for the interceptor's exoatmospheric kill vehicle—an upgraded infrared seeker and onboard discrimination—are still not yet fully mature. Although the GMD program expected to integrate these technologies and field the enhanced interceptor in fiscal year 2008, the program was not able to do so because of problems during development of certain components. According to program officials, the program delivered the first two upgraded EKV units in the first quarter of fiscal year 2009 for emplacement; however, the upgraded EKV's capability will not be assessed through flight tests until at least fourth quarter fiscal year 2009.

Design Maturity

The design of the fielded interceptor appears stable with 100 percent of its drawings released to manufacturing. However, according to program officials, planned refurbishment of the emplaced interceptors revealed some unexpected issues. Efforts to address these issues are in the early stages, and the number of drawings may increase as a result. Additionally, the design of the enhanced interceptor may not be complete because two technologies are still being developed and have not had their capability verified through flight testing.

Production Maturity

We did not assess the maturity of the production processes for GMD interceptors. While the program is buying interceptors for operational use, officials do not plan to make an official production decision or collect statistical control data because the planned quantities are small.

Other Program Issues

GMD's flight test program continues to experience delays, which impedes realistic evaluation of GMD's capability. For example, two flight tests with intercepts were planned for fiscal year 2008; however, the program was unable to conduct either intercept attempt. The first, FTG-04, had already gone through six configuration alterations before it was subsequently cancelled and restructured into a sensor integration test utilizing only a simulated interceptor. The second flight test, FTG-05, was altered to support the objectives of the cancelled FTG-04 test; however, it was delayed until December 2008, when it resulted in a successful intercept. Not all objectives were achieved, however, because the target did not deploy its countermeasures, reducing the complexity of the test.

The program has begun a scheduled refurbishment effort for emplaced interceptors to deal with less reliable parts that were incorporated into the booster and kill vehicle. According to program officials, this effort uncovered unexpected issues in some emplaced interceptors. To address this problem, MDA is undertaking, in some cases, what the program calls an extensive level of refurbishment. However, it is not yet clear how the expanded refurbishment will affect the program's cost and schedule.

We estimate that at contract completion, the GMD prime contractor, Boeing, could experience a cost overrun over $1.0 billion on the $17.3 billion contract. However MDA officials believe that ongoing baseline adjustments have affected current variances to a degree that they are not accurate predictors of future costs. Additionally, the Defense Contract Managment Agency reports that replanning has produced artificial positive schedule variances in fiscal year 2008.

Program Office Comments

GMD provided technical comments, which we incorporated as appropriate.

BMDS Kinetic Energy Interceptors (KEI)

MDA's KEI element is a missile defense system designed to destroy medium, intermediate, and intercontinental ballistic missiles during boost and midcourse phases of flight. The program was restructured in April 2007 and is now only developing the booster components of the system. MDA deferred work on its kill vehicle, fire control, and launcher. The program plans to utilize multiple kill vehicles as a future payload. Although MDA is considering land- and sea-based options, we assessed the baseline land-based, mobile launch booster.

Source: Northrop Grumman Space and Mission System.

Technology/system development

Program start (10/02)	Prime contractor selection (12/03)	Element system requirements review (9/08)	GAO review (1/09)	Booster flight test (3rdQ/FY09)	Preliminary design review (9/10)	Design review (12/11)	Initial capability (TBD)

Program Essentials

Prime contractor: Northrop Grumman
Program office: Huntsville, AL
Funding FY09-FY13:
- R&D: $2,753.3 million
- Procurement: NA
- Total funding: $2,753.3 million
- Procurement quantity: NA

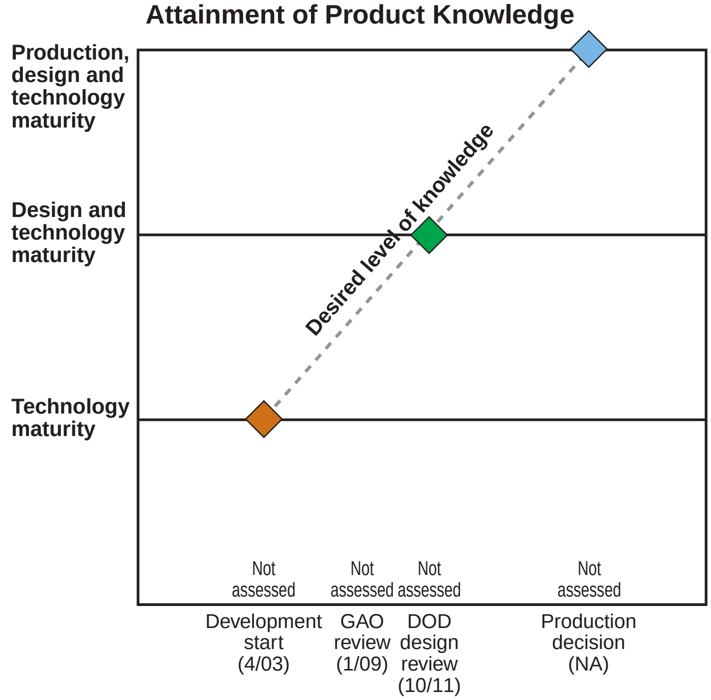
Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2007	Latest 09/2008	Percent change
Research and development cost	$4,118.9	$4,212.0	2.3
Procurement cost	NA	NA	NA
Total program cost	$4,118.9	$4,212.0	2.3
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013.

As a result of an April 2007 program restructure, KEI is only responsible for developing four technologies related to the interceptor's booster. These four technologies are immature, even though the program has been in development since 2003. The KEI program office also reported that none of its design drawings are releasable and that the design is not projected to be stable by its 2011 design review. The program is working towards its next key knowledge point, a booster flight test (FTK-01) planned for third quarter, fiscal year 2009, intended to confirm boost phase capability. FTK-01 has slipped nearly a year due to qualification and static fire testing issues. These delays have compressed the program's schedule leading up to and beyond the test. Program officials have stated that the test could slip to as late as fourth quarter fiscal year 2009.

Attainment of Product Knowledge



KEI Program

Technology Maturity

In April 2007, MDA issued a stop work order on the KEI development contract and restructured the program to focus on booster development, including four critical technologies—the attitude control system (ACS), booster motors, third-stage rocket motor, and trapped ball thrust vector control. These, and the identified backup technologies, remain at relatively low levels of maturity. At development start, all of the critical technologies were still being demonstrated in a lab or through analytical studies—a low level of maturity. Program officials plan to do a prototype demonstration of form, fit, and function in a relevant environment for the booster motors and trapped ball thrust vector control by the 2011 design review. However, at this time, program officials have stopped development of the third-stage rocket motor and the ACS until after the FTK-01 and have no plans to mature these technologies by that point. Work on the kill vehicle, fire control, and launcher components has been deferred.

Of the 21 critical technologies reported last year, KEI transferred responsibility for 16 technologies back to the Multiple Kill Vehicle (MKV) program and one technology to the Space Tracking and Surveillance System (STSS) Program. While the KEI program intends to utilize the multiple kill vehicles as a future payload as well as the STSS program's algorithms that enable the kill vehicle to discriminate between the exhaust plume and the missile body itself, it is not responsible for their development. Program officials will decide whether or not to pursue development of the deferred technologies after the FTK-01 test has been completed.

Design Stability

The design of the KEI program is not projected to be stable by its critical design review in 2011. According to the program office, none of the design drawings are currently releasable and none will be releasable at the critical design review. At the program restructure in April 2007, the estimated number of design drawings decreased from 7,500 to 1,500. The updated count includes the estimated number of drawings for the KEI's canisterized booster program. It excludes the kill vehicle, fire control, and launcher components.

Other Program Issues

The KEI program's next key knowledge point is FTK-01, which is intended to confirm the boost phase capability as an alternative to the Airborne Laser and the high acceleration booster as a capability for midcourse defense. This flight test has been delayed by approximately 1 year due to technical issues discovered during ground testing. Component failures during acceptance testing, as well as during the second-stage static fire test in 2007, delayed the program and the flight test by at least 9 months from the fourth quarter of fiscal year 2008 until mid-2009. Program officials told us that hardware issues discovered during qualification testing will likely delay the flight test further to the fourth quarter of fiscal year 2009.

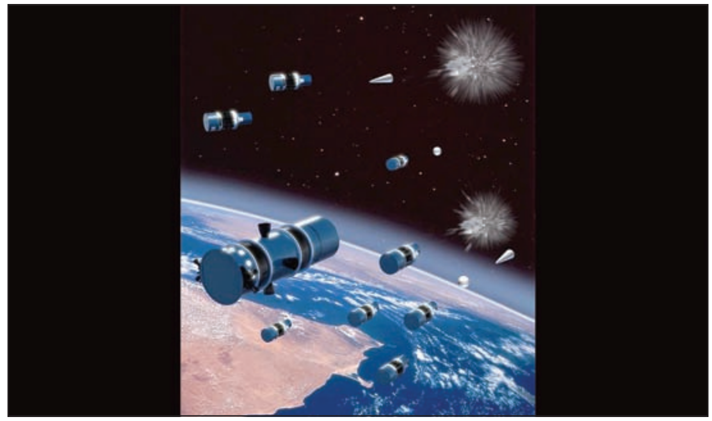
The KEI program is experiencing both short-term and long-term schedule compression due to recent delays in ground and flight testing. In the short-term, the program has compressed the time to analyze test results for the four static fire tests leading up to FTK-01 in the third quarter, fiscal year 2009. While program officials told us it generally takes 60-90 days to produce a test report, the average time between static fires in fiscal year 2009 is about a month, making it difficult to recognize or fix issues encountered on the current static test before the next test is conducted. In the long-term, the program has delayed FTK-01 by nearly a year, but has adjusted the date of the critical design review planned for 2011 by only a quarter. Consequently, there will be less time to conduct the activities planned between these two key events and stablilize the design after the booster has been tested.

Program Office Comments

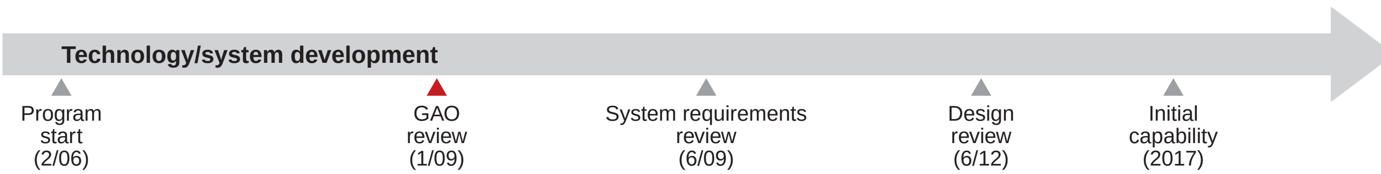
In commenting on a draft of this assessment, the KEI program office stated that work is currently being conducted only on the first- and second-stage rocket motors and the thrust vector control system. After FTK-01, the ACS and third-stage rocket motor work will begin. Program officials stated they have added several risk reduction activities to increase confidence in flight vehicle performance and have resequenced tasks to relieve some of the short term schedule compression. Program officials believe that the timing asymmetry for the FTK-01 and design review is not a reason for concern as most supporting activities are accomplished in parallel.

BMDS Multiple Kill Vehicle (MKV)

MDA's MKV is being designed as a modular payload for midcourse defense system interceptors including the Ground-based and Kinetic Energy Interceptors. The original payload concept is to engage midcourse threat clusters by deploying multiple kill vehicles from a larger carrier vehicle. In September 2007, the program awarded a second contract to develop an alternative concept for multiple kill capability. Our assessment focuses on the original contractor's concept, which has an expected initial capability around 2017.



Source: Lockheed Martin.



Program Essentials

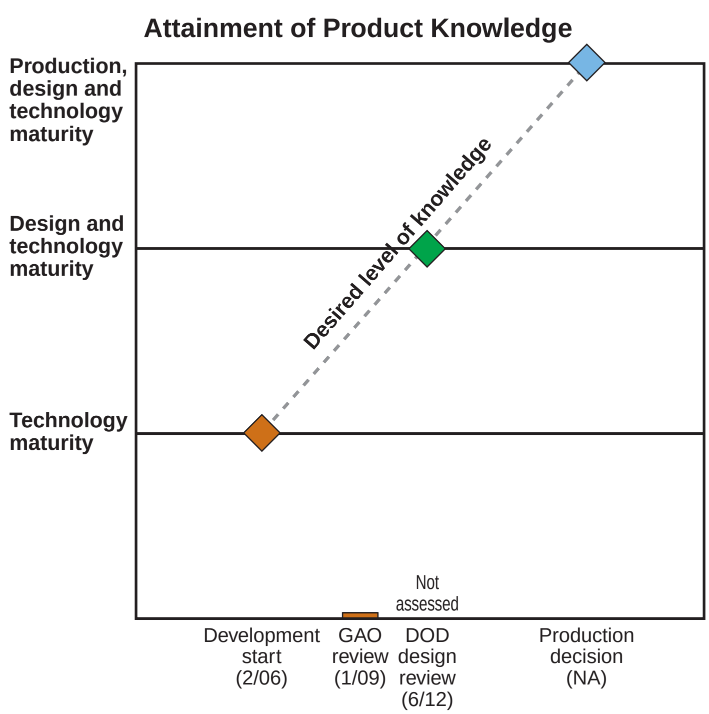
Prime contractor: Lockheed Martin, Raytheon
Program office: Huntsville, AL
Funding FY09-FY13:
- R&D: $2,849.1 million
- Procurement: NA
- Total funding: $2,849.1 million
- Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2007	Latest 11/2008	Percent change
Research and development cost	$3,216.1	$3,269.1	1.6
Procurement cost	NA	NA	NA
Total program cost	$3,216.1	$3,269.1	1.6
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013.

According to the program office, the MKV program transitioned to an acquisition program and began system development in 2006 without setting top-level requirements for the payload. The program plans to set these requirements in 2009. Until this occurs, it is uncertain whether the technologies under development by the program will satisfy the final requirements. We assessed none of the 16 critical technologies as mature, although the program office assessed 13 of the 16 critical technologies as nearly mature. Although we reported the carrier vehicle's divert and attitude control system as nearly mature last year, the program changed the technology and subsequently lowered its maturity level. The program has completed the first of three phases to mature the engagement algorithms critical to the system's ability to engage targets with multiple kill vehicles.



MKV Program

Technology Maturity

None of the MKV element's 16 technologies are mature. The carrier vehicle's critical technologies include the divert and attitude control system (DACS), cooler, inertial measurement units (IMU), focal plane array (FPA), optics, power, processor, and carrier vehicle-ground datalink. The technologies critical to the kill vehicle include the DACS, seeker FPA, cooler, optics, IMUs, power, processors, and carrier vehicle-to-kill vehicle datalink. Last year we reported that the carrier vehicle DACS was nearing maturity; however, the program made a determination to change the technology and lower the TRL level accordingly since this new design has not been tested in the form, fit, and function for the MKV element. According to the program, all sixteen critical technologies are nearly mature with the exception of the carrier vehicle's DACS, optics, and focal plane array. We continue to disagree with this assessment since none of the technologies have been repackaged and successfully tested in the correct form and fit. It is unclear when the program's critical technologies will be demonstrated in the correct form, fit, and function for the payload to achieve full maturity.

The program office has not set top-level requirements for the MKV payload and does not plan to do so until 2009. Program officials told us that the way forward was based on understanding objectives for the Ballistic Missile Defense System (BMDS) and the capabilities available, synthesizing those capabilities into the BMDS based on their benefit then, lastly, setting requirements at the BMDS level down to the payload level. However, until the requirements are approved, it is uncertain whether the technologies under development by the program will satisfy those final requirements.

In May 2008, the program office completed a modeling and simulation exercise as the first of three phases in its efforts to demonstrate its engagement management algorithms. This capability is critical to the system's ability to engage targets with multiple kill vehicles. The program plans to demonstrate their functionality in an integrated hardware and software test planned for 2011. According to program officials, without this capability, the program would instead pursue unitary kill vehicles—much like the Ground-based Midcourse Defense System's Exoatmospheric Kill Vehicle.

Other Program Issues

Since September 2007, Raytheon has performed work on an alternative MKV concept as a subcontractor on the Kinetic Energy Interceptor (KEI) program. In October 2008, MDA awarded an indefinite delivery/indefinite quantity contract to Raytheon worth $441.9 million through 2011 to continue work on the alternative concept. Lockheed Martin, the original MKV contractor, will continue to work in parallel with Raytheon. Although the program has two prime contractors for the MKV element, program officials told us the contractors would not be in competition and that there are currently no plans to downselect to one contractor.

In 2008, MDA renamed the MKV program office as the BMDS Kill Vehicles program office and placed management of the MKV element and all other unitary kill vehicles under its direction. Although programs finance the development of their individual kill vehicles, the BMDS Kill Vehicles program office is responsible for their management to foster an integrated and modular approach to producing kill vehicles.

Program Office Comments

The program office states that MDA has demonstrated all 16 technologies successfully and identified a rigorous set of knowledge points in order to mature the design. MDA plans to accomplish this through both realistic component development and testing—ground and flight testing. Officials state that requirements follow demonstrated capabilities that exploit design margin and that efficiencies gained through commonality among the kill vehicles enable the agency to make focused investments with the contractor and vendor base.

GAO Response

We maintain that although some testing of the critical technologies has been accomplished, until the technologies are repackaged into the correct form, fit, and function for the MKV and tested in a realistic environment, they cannot be considered mature. Additionally, we believe that until requirements are approved, uncertainties remain as to whether technologies under development will satisfy those final requirements.

BMDS Space Tracking and Surveillance System (STSS)

MDA's STSS element is being developed in incremental, capability-based blocks designed to track enemy missiles throughout their flight. The initial increment is composed of two demonstration satellites started under the Space Based Infrared System Low program. MDA plans to launch these satellites in 2009 to assess how well they work within the context of the missile defense system. If successful, MDA also plans to develop a yet-to-be-defined operational constellation of STSS satellites. We assessed the two demonstration satellites.

Source: Photo courtesy of Northrop Grumman Space Technology.

Program Essentials

Prime contractor: Northrop Grumman Space Technology
Program office: El Segundo, CA
Funding FY09-FY13:
R&D: $2,524.0 million
Procurement: NA
Total funding: $2,524.0 million
Procurement quantity: NA

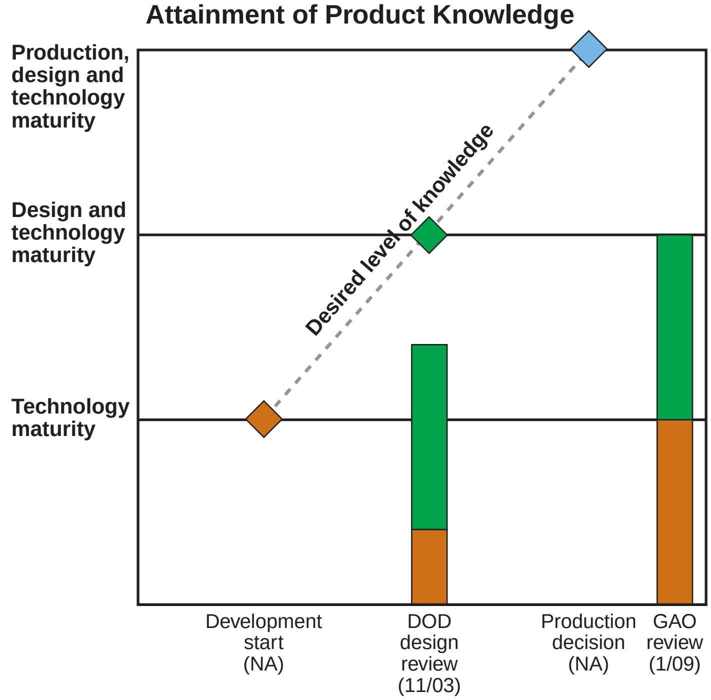
Program Performance (fiscal year 2009 dollars in millions)

	As of 09/2007	Latest 08/2008	Percent change
Research and development cost	$6,723.0	$6,380.6	-5.1
Procurement cost	NA	NA	NA
Total program cost	$6,723.0	$6,380.6	-5.1
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2013, including the potential operational constellation to be defined.

Both STSS demonstration satellites have been built. All five critical technologies are mature, and the design appears stable. In the last year, the scheduled launch of the satellites has been delayed again from April 2008 to June 2009, and further schedule slips are possible. At one point, MDA set a November 2008 launch date. However, the program lost its position on the launch schedule due to issues with the launch manifest. After the slip was identified, hardware issues arose, which further necessitated the slip. According to program officials, the program office has also experienced staffing and budget shortfalls that have had an adverse effect on the program. All of these factors—technical issues, launch site availability, staffing, and funding—are risks that the program will have to address to meet its planned June 2009 launch date.

Attainment of Product Knowledge



STSS Program

Technology & Design Stability

All five critical technologies reached maturity when thermal vacuum testing on the first satellite's payload was completed in February 2006. The program's design is stable, with all drawings released to manufacturing. Both STSS demonstration satellites have been built.

Other Program Issues

In the past year, the launch of the demonstration satellites was delayed from April 2008 to June 2009 because of hardware problems on the second space vehicle. For example, a flight communications box overheated during testing. The program office thoroughly tested the usability of the unit, and the unit was successfully tested, does not have to be replaced, and is acceptable for flight. In addition, there were failures in both the main spacecraft computer and the reprogrammable memory of one of the two payload computers. The program office initially recommended the removal of the entire computer from the spacecraft to fix the problem. After extensive research and testing, the program manager determined that the event with the spacecraft computer is currently an unverifiable failure with low probability of occurrence and low mission impact. According to the program manager, the spacecraft computer will not be removed, which will eliminate the need to repeat integration testing.

According to program officials, the program office has experienced staffing shortages and budget cuts that have had an adverse effect on the program. According to the program office, five of the program's top system experts were recently reassigned. In addition, the Air Force removed eight junior officers from the program as part of a recent force-shaping initiative, thereby creating a knowledge and experience gap. As a result, current program office personnel are taking on increased workloads to accomplish critical tasks in preparation for the launch of the satellites. The program manager stated that he has had to rely much more on contractor support for systems engineering than in the past. According to MDA, however, the Air Force has committed to fully staffing the program office and has begun appropriate fiscal year 2009 personnel requisitions to support that commitment.

The program manager is also making changes to the STSS program to account for receiving less funding than was requested in the President's fiscal year 2009 budget. The program intends to stretch out the planned software upgrades for the ground segment and demonstration satellites—with the final updgrades delayed by almost 2 years. Since only one of the four software drops is now projected to be available by the time the satellites are on-orbit, functioning, and ready to transmit data after the 6-month checkout period, data from the satellites may not be fully utilized by external users. The program office is considering plans to reduce the amount of on-orbit testing by going to a "day-shift only" operation rather than the around-the-clock schedule currently planned. If this plan is implemented, the amount of testing that can be accomplished will be reduced and it will take longer to analyze test data and make data available.

The program did make progress in the past year. In August 2008, the demonstration satellites successfully completed acoustics environmental testing, during which both space vehicles are stacked in their launch configuration and subjected to the acoustic environment they will experience during launch. Final factory testing of the second space vehicle is also underway.

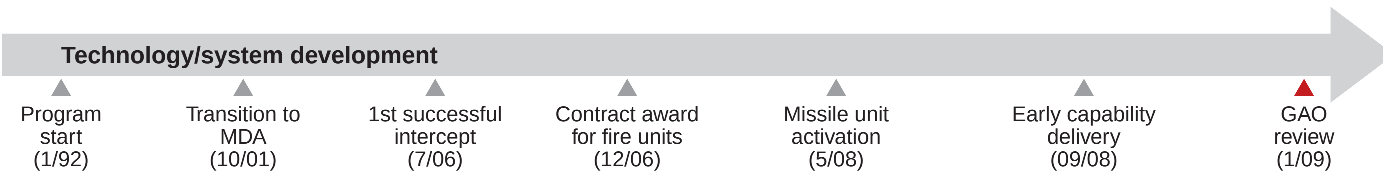
Program Office Comments

MDA stated that the assessment was an accurate depiction of the program at this point in time. MDA also provided technical comments, which were incorporated where appropriate.

BMDS Terminal High Altitude Area Defense (THAAD)

MDA's THAAD element is being developed in incremental, capability-based blocks to provide a ground-based missile defense system able to defend against short- and medium-range ballistic missile attacks. THAAD will include missiles, a launcher, an X-band radar, and a fire control and communications system. We assessed the design for the initial fire unit that MDA plans to deliver to the Army in fiscal year 2010 for limited operational use.

Source: THAAD Project Office/MDA, Release.



Program Essentials

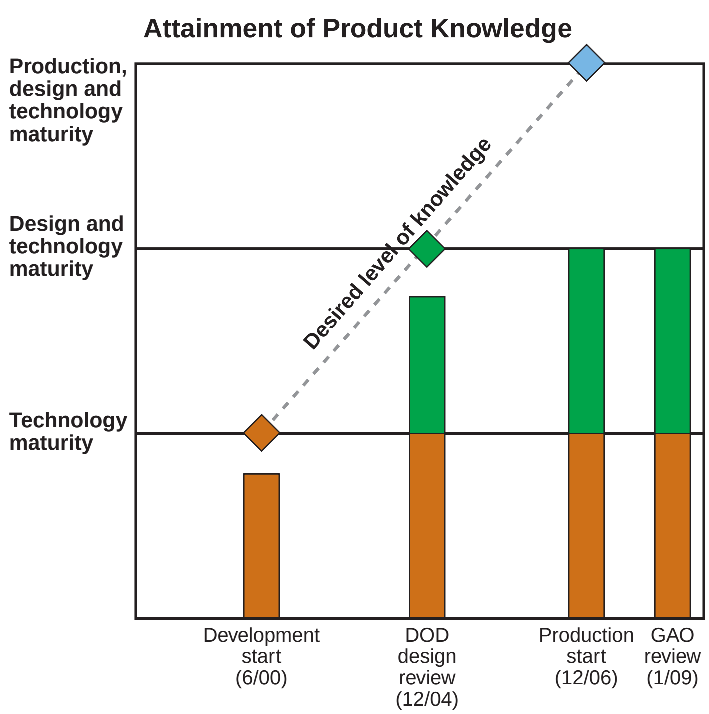
Prime contractor: Lockheed Martin
Program office: Huntsville, AL
Funding FY09-FY13:
- R&D: $2,635.2 million
- Procurement: NA
- Total funding: $2,635.2 million
- Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 09/2007	Latest 07/2008	Percent change
Research and development cost	NA	$15,123.7	NA
Procurement cost	NA	NA	NA
Total program cost	NA	$15,123.7	NA
Program unit cost	NA	NA	0.0
Total quantities	NA	NA	0.0
Acquisition cycle time (months)	NA	NA	0.0

Columns include costs from the program's inception through fiscal year 2013. Totals do not include sustainment funds.

THAAD's technologies are mature and its design appears stable, with 99 percent of its design drawings released; however, since the program is still in development and conducting flight tests, additional design work may be necessary. MDA has purchased two operational fire units, however it will not assess production maturity until a formal production decision is made. In fiscal year 2008, the program successfully conducted two of three scheduled tests. The first test demonstrated an intercept outside of the atmosphere. The second test was a successful intercept of a separating target inside the atmosphere. According to program officials, the third test was designated a "no test" because of a target failure. During fiscal year 2008, the program continued to mature THAAD's design, and it expects to deliver the first THAAD battery to the Army in fiscal year 2010.



THAAD Program

Technology Maturity

Program officials assessed all of THAAD's critical technologies as mature. All of these technologies are included in four major components: the fire control and communications component, the interceptor, the launcher, and the radar.

Design Maturity

Approximately 99 percent of THAAD's 14,606 drawings have been released indicating that THAAD's design is generally stable. The number of drawings has increased since 2003 because previously excluded drawings were added for radar and missile components. Additional drawings or design work could still be required based on the results of remaining ground and flight testing.

Production Maturity

We could not assess THAAD's production maturity because the program has not collected data on its key production processes. MDA does not plan to assess production maturity until a formal production decision is made. In December 2006, MDA ordered two fire units that will be operational systems and ultimately fielded. The first THAAD battery will be provided to the Army in fiscal year 2010, with the second expected to become available during fiscal year 2011. Prior to a formal production decision, the program office plans to assess production maturity using risk assessments and verification reviews to ensure that the contractor's processes are repeatable and of high quality.

Other Program Issues

In fiscal year 2008, the THAAD program successfully conducted two of three scheduled flight tests. The first two tests resulted in successful target intercepts inside and outside of the atmosphere while demonstrating the radar, launcher, and fire control and communications capabilities. The third test, designated by MDA as a key risk reduction test, resulted in a "no test" because the target failed. This flight test was also intended to be the first developmental/operational test of the THAAD system that included the launch of multiple THAAD interceptors and a separating target. THAAD expects to conduct a replacement test during the second quarter of fiscal year 2009.

The THAAD program has experienced funding shortfalls that have delayed the delivery of a limited operational capability to the Army. The funding shortfalls have been driven in part by cost overruns and target availability problems that have caused the flight test program to be restructured. Target availability issues have cost the THAAD program approximately $175 million in the past 2 fiscal years. As a result of these funding pressures, the THAAD program has deferred the fire unit 1 and 2 interceptor deliveries (50 interceptors) by 6 months.

Hardware issues and technical problems are still causing the program's prime contractor to experience negative cost variances. The variance can primarily be attributed to the missile, launcher, and radar. As of September 2008, the THAAD program was overruning its fiscal year 2008 budget by $34.0 million.

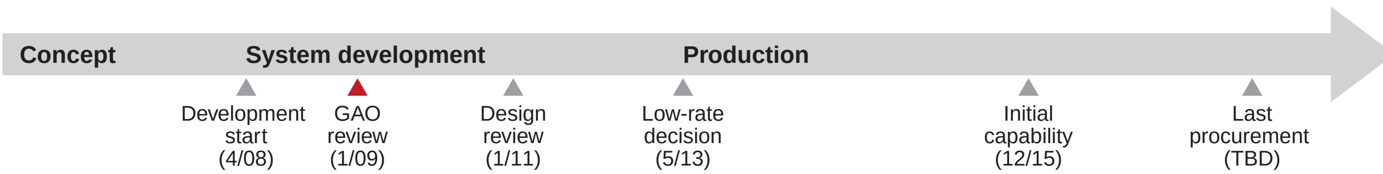
Program Office Comments

THAAD provided technical comments, which we incorporated as appropriate.

Broad Area Maritime Surveillance Unmanned Aircraft System

The Navy's Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS) is to provide a persistent maritime intelligence, surveillance, and reconnaissance (ISR) capability. Along with the P-8A Multi-mission Maritime Aircraft and the future EP-X electronic surveillance aircraft, BAMS UAS will be part of a maritime patrol and reconnaissance force family of systems integral to the Navy's recapitalization of its airborne ISR.

Source: PMA-262.



Program Essentials

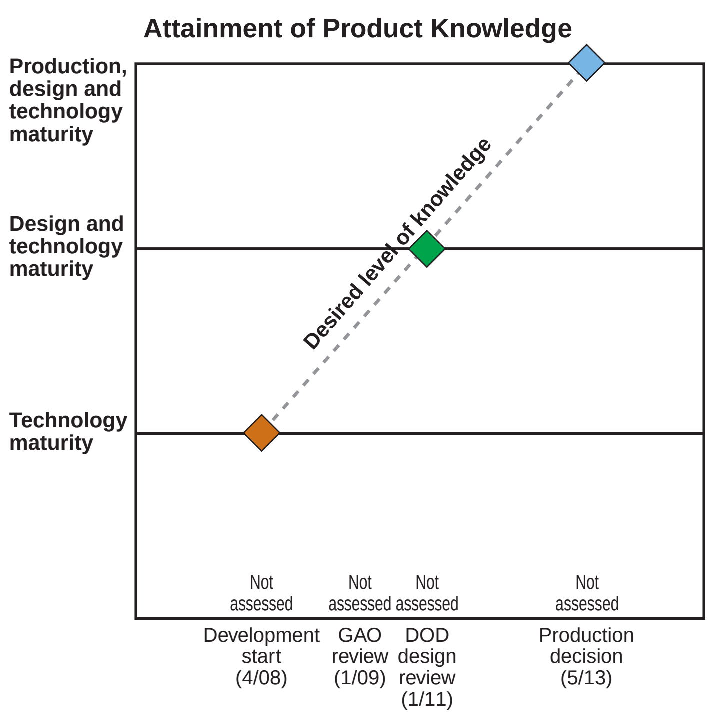
Prime contractor: Northrop Grumman Systems Corporation
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $2,060.8 million
- Procurement: $707.7 million
- Total funding: $2,887.7 million
- Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 04/2008	Latest 09/2008	Percent change
Research and development cost	NA	$2,268.7	NA
Procurement cost	NA	$707.7	NA
Total program cost	NA	$3,095.6	NA
Program unit cost	NA	$44.222	NA
Total quantities	NA	70	NA
Acquisition cycle time (months)	NA	92	NA

Column labeled "latest" includes known costs through fiscal year 2013. Total quantities extend beyond fiscal year 2013.

The BAMS UAS program began system development in August 2008 with all technologies approaching maturity. The program received approval from DOD to begin system development in April 2008, but the source selection was subject to a bid protest that delayed development start to August 2008. Program officials explained that the program has no critical technologies according to a technology readiness assessment conducted in 2007. However, six watch-list technologies have been identified that could affect system development. The BAMS UAS initial operational capability has been delayed from August 2014 to December 2015.



BAMS UAS Program

Technology Maturity

In 2008, DOD and the Navy concluded that all BAMS UAS technologies were approaching maturity and have been demonstrated in a relevant environment. This assessment also concluded that the program had no critical technologies. Though not considered critical technologies, the program office has identified six subsystems, such as the due-regard radar that could cause cost, schedule, or performance issues during development. Other subsystems include the multi-spectral targeting system, multi-function active sensor rotary joint, automatic dependant surveillance-broadcast, on-board image formatting, compression, and reduction, and smart image bandwidth management. Program officials indicated that they are monitoring the development risks for these subsystems. The decision to allow the program to begin system development also included a requirement for an additional independent technology readiness assessment. It is to be conducted and submitted for DOD review once the preliminary design review has been completed.

Other Program Issues

BAMS UAS is intended to serve as an adjunct to the P-8A Multi-mission Maritime Aircraft. The Navy intends to position BAMS UAS mission crews with maritime patrol and reconnaissance forces personnel to allow operators to closely coordinate missions and utilize a common support infrastructure. According to program officials, BAMS UAS plans to achieve full operational capability in time to avoid a capability gap due to the retirement of the P-3C Orion aircraft.

Program officials explained that BAMS UAS air vehicle is about 78 percent common by weight to the Air Force Global Hawk and leverages sensor components or entire systems from other DOD platforms. In addition, the BAMS UAS program is leveraging lessons learned from that program and has established a Memorandum of Agreement with the Global Hawk program office.

The BAMS UAS requirements and schedule align with the Australian AIR 7000 program. According to program officials, a system development and demonstration (SDD) Memorandum of Understanding will be negotiated if the Australian government decides to form a BAMS UAS cooperative program. Australian unique objectives were included in the BAMS UAS SDD contract as separately priced options. Prior project arrangements focused on modeling and simulation development and engineering risk reduction activities.

Program Office Comments

In commenting on a draft of this assessment, the BAMS UAS program office provided technical comments, which were incorporated as appropriate.

C-130 Avionics Modernization Program

The Air Force's C-130 AMP standardizes the cockpit and avionics for three combat configurations of the C-130 fleet, which provides increased reliability, maintainability, and sustainability. The program is intended to ensure C-130 global access and deployability by satisfying navigation and safety requirements, installing upgrades to the cockpit systems, and replacing many systems no longer supportable due to diminishing manufacturing resources.

Source: C-130 Avionics Modernization Program.

Concept | System development | Production

Development start (7/01) | Design review (8/05) | GAO review (1/09) | Low-rate decision (TBD) | Full-rate decision (1/12) | Last procurement (2017)

Program Essentials

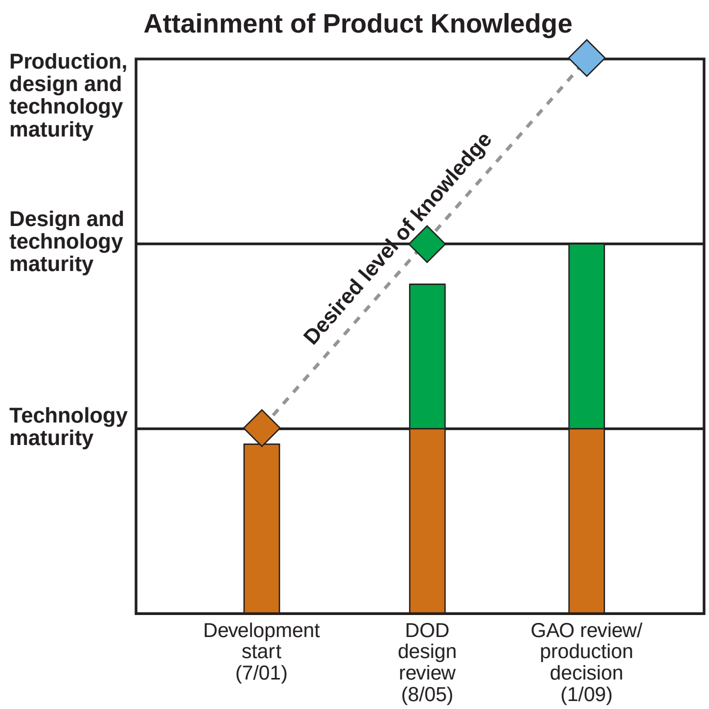
Prime contractor: Boeing
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $362.3 million
- Procurement: $3,465.0 million
- Total funding: $3,827.2 million
- Procurement quantity: 216

Program Performance (fiscal year 2009 dollars in millions)

	As of 07/2001	Latest 08/2008	Percent change
Research and development cost	$749.0	$1,919.0	156.2
Procurement cost	$3,242.3	$3,493.5	7.7
Total program cost	$3,991.3	$5,412.4	35.6
Program unit cost	$7.690	$24.491	218.5
Total quantities	519	221	-57.4
Acquisition cycle time (months)	NA	NA	NA

Latest cost data do not fully account for changes following the critical Nunn-McCurdy unit cost breach. As of December 2008, the C-130 AMP program had not completed an updated cost estimate.

The C-130 AMP's technologies are mature and its design is stable. The program does not collect process control data to demonstrate production maturity. In 2008, the program finalized a restructuring that resulted from a critical Nunn-McCurdy unit cost breach. However, completion of its production decision has been delayed until January 2009 primarily because of software testing issues and a failure to complete required documentation. The program has been authorized to procure two AMP kits prior to the production decision to preserve its test schedule. Still, cost and schedule risks remain. Flight testing of a production representative aircraft began in August 2008, but the airdrop capability has yet to undergo a full operational assessment. The Air Force has proposed a second phase to the AMP, which would provide avionics upgrades to C-130s not included in the current program.



C-130 AMP Program

Technology Maturity

The three C-130 AMP critical technologies—global air traffic management, defensive systems, and combat delivery navigator removal—are mature. As part of the program restructuring that resulted from a critical Nunn-McCurdy unit cost increase breach, the number of critical technologies for the program was cut in half from six to three. The removed technologies were intended for Special Mission C-130 aircraft configurations, which were eliminated from the program during the restructure.

Design Maturity

The design of the C-130 AMP combat delivery configuration is stable, with all of the expected drawings releasable to manufacturing. The program believes it has addressed past integration issues that stemmed from underestimating the complexity of the engineering efforts needed to modify the different C-130 aircraft configurations. The program has more recently encountered software delays with its production software package. These software problems have contributed to a series of delays to the program's production decision, which is now expected to be completed in January 2009.

Production Maturity

We could not assess production maturity because the program does not collect statistical process control data on its critical manufacturing processes. However, according to program officials, the Air Force and the contractor will use detailed, proven work instructions to control the installation quality and will conduct inspections to ensure installations are performed as planned. In addition, factory metrics associated with quality and productivity are collected.

The C-130 AMP's low-rate initial production decision will not be finalized until January 2009 primarily due to software testing issues and problems completing required documentation. In order to prevent this delay from affecting the program's initial operational test and evaluation schedule, the Undersecretary of Defense for Acquisition, Technology and Logistics authorized the program to buy two AMP kits in advance of its production decision. The program began flight testing of a production representative aircraft in August 2008. Nevertheless, other issues could affect the test schedule or pose cost and schedule risks for the program in production. According to an operational assessment completed by the Air Force Operational Test and Evaluation Center, late aircraft availability poses a risk to maintaining the current test schedule. In addition, the program's airdrop capability has not undergone a full operational assessment. Specifically, final hardware and software installation, which provides situational awareness functionality, was not completed before the Air Force's operational assessment.

Other Program Issues

The Air Force has proposed including a second phase to the AMP in its fiscal year 2010 budget request. The second phase would provide the avionics modernization to C-130 aircraft that are not part of the 221 aircraft included in the current program baseline. The cost of this effort is estimated to be $870 million over 5 years.

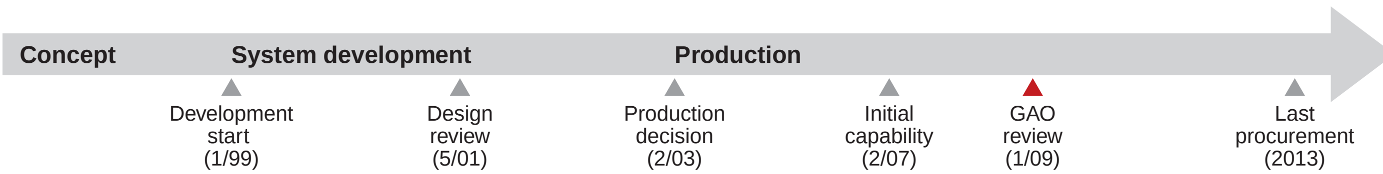
Agency Comments

The Air Force concurred with this assessment and provided technical comments, which were incorporated where appropriate.

C-5 Avionics Modernization Program (C-5 AMP)

The Air Force's C-5 AMP is the first of two major upgrades for the C-5 to improve mission capability rate and transport capabilities and to reduce ownership costs. The AMP incorporates Global Air Traffic Management, navigation and safety equipment, modern digital equipment, and an all-weather flight control system. The second major upgrade, the C-5 Reliability Enhancement and Reengining Program (RERP), replaces the engines and modifies the electrical, fuel, and hydraulic systems. We assessed the C-5 AMP here and the C-5 RERP separately.

Source: Edwards AFB.



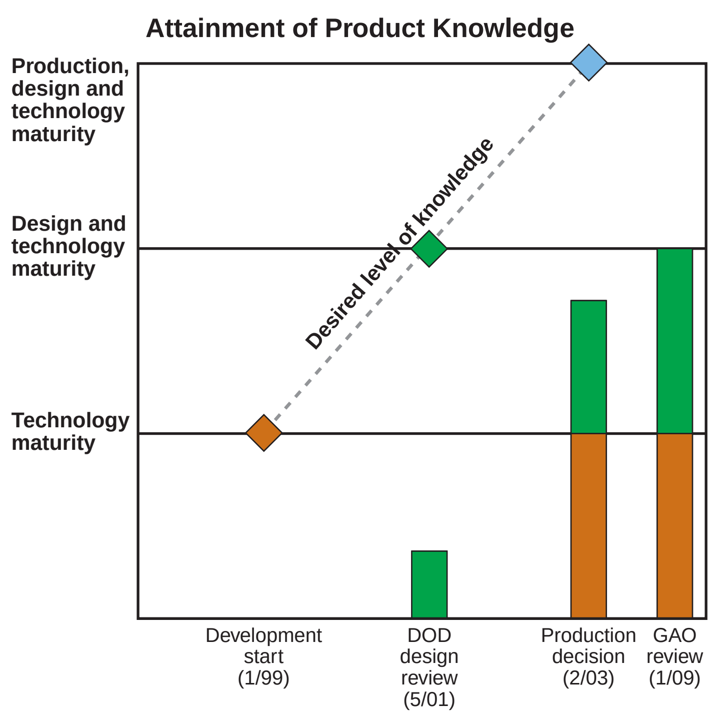
Program Essentials

Prime contractor: Lockheed Martin
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: $1.8 million
Procurement: $415.5 million
Total funding: $417.3 million
Procurement quantity: 42

Program Performance (fiscal year 2009 dollars in millions)

	As of 11/1998	Latest 12/2007	Percent change
Research and development cost	$387.5	$468.4	20.9
Procurement cost	$677.8	$1,001.5	47.7
Total program cost	$1,065.4	$1,469.8	38.0
Program unit cost	$8.455	$13.124	55.2
Total quantities	126	112	-11.1
Acquisition cycle time (months)	83	97	16.9

The C-5 AMP technologies and design are used in other aircraft and considered mature. We did not assess production maturity as the components are commercial off-the-shelf items. Operational testing identified 250 deficiencies and assessed the AMP as partially mission capable. Some of the deficiencies have since been resolved and others are being addressed in future AMP software builds and the C-5 RERP. The AMP was fielded with waivers to 14 specification requirements. The C-5 RERP will address 4 of these requirements. Other deficiencies and waivers may be addressed in a new modernization program slated for fiscal year 2010. The AMP is addressing some diminishing manufacturing source problems with the navigation system and backup integrated processor. The Air Force is currently conducting a mobility capabilities requirement study which may or may not affect future C-5 AMP requirements.



C-5 AMP Program

Technology Maturity

We did not assess the C-5 AMP's critical technologies because the program uses commercial technologies that are considered mature.

Design Maturity

The program reports that the contractor has now released all of the drawings for the AMP.

Production Maturity

We could not assess the production maturity because most components are readily available as commercial off-the-shelf items. This equipment is being used on other military and commercial aircraft. To ensure production maturity, the contractor annually surveys its suppliers to assess future availability of AMP modification kits and works with the program office and end user to ensure that installations can be completed according to the installation schedule.

The program is addressing diminishing manufacturing source issues related to the navigation system and the backup integrated processor. The program will be installing an upgraded and certified navigation system, due to a diminishing manufacturing source issue, for C-5s receiving the modification starting in 2010.

Other Program Issues

According to the Director of Operational Test and Evaluation, the AMP is partially mission capable, however, not operationally suitable. About 250 deficiencies, including software issues related to autopilot disconnects, were found during testing, and 14 specification requirements that affect operational requirements have been waived.

A total of 37 deficiencies will be corrected in C-5 RERP and an additional 6 deficiencies will be fixed if the RERP Operational Flight Plan 3.4 software build is fielded. In addition, 73 more deficiency reports have been corrected or are being corrected as part of a sustainment contract software build that will be released in March 2009. C-5 RERP has addressed 4 of the 14 previously waived specification requirements, such as the Auto Take Off and Go Around functionality and memory improvement for the Flight Management System database. Other deficiencies and waivers may be addressed in a modernization block upgrade program beginning in 2010. DOD has currently funded $65 million for the initial upgrades; additional funding will be requested in 2012 and beyond to provide additional capabilities.

Fewer C-5s may need the AMP modification if the Air Force decides to retire some of its C-5 aircraft. This decision is not likely to be made until after the results of the current mobility capabilities requirement study are released in May 2009. As of November 2008, the Air Force has modified 45 aircraft, 1 C-5A, 2 C-5Cs, and 42 C-5Bs with over 43,300 operational flight hours.

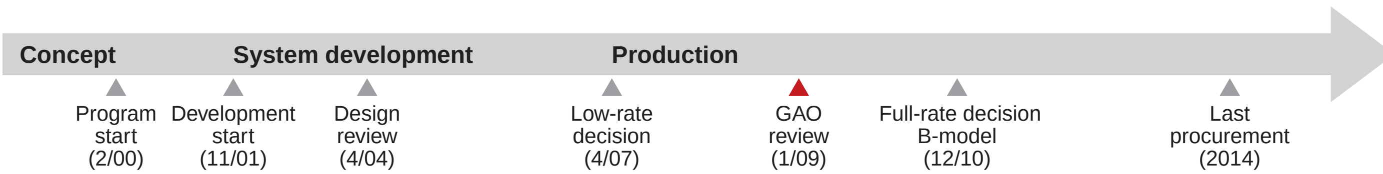
Program Office Comments

The Air Force provided technical comments to a draft of this assessment, which were incorporated as appropriate.

C-5 Reliability Enhancement and Reengining Program (C-5 RERP)

The Air Force's C-5 RERP is one of two major upgrades for the C-5. The RERP is designed to enhance the reliability, maintainability, and availability of the C-5 by replacing the propulsion system and modifying the mechanical, hydraulic, avionics, fuel, and landing gear systems as well as other structural modifications. Together with the C-5 Avionics Modernization Program (AMP), these upgrades are intended to improve the mission capability rates and reduce total ownership costs. We assessed the C-5 RERP here and the C-5 AMP separately.

Source: Edwards AFB.



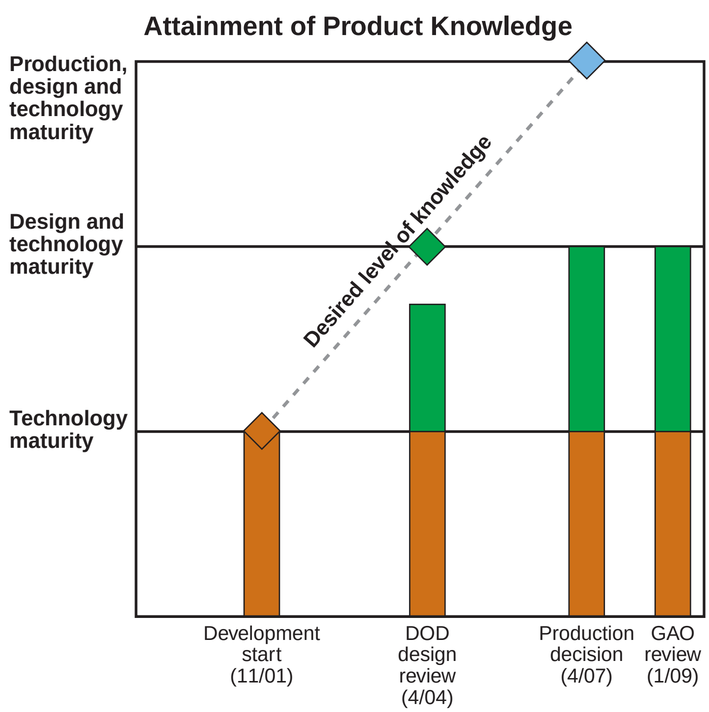
Program Essentials

Prime contractor: Lockheed Martin
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $240.7 million
- Procurement: $5,295.6 million
- Total funding: $5,544.3 million
- Procurement quantity: 48

Program Performance (fiscal year 2009 dollars in millions)

	As of 11/2001	Latest 06/2008	Percent change
Research and development cost	$1,692.7	$1,757.3	3.8
Procurement cost	$8,836.3	$5,524.2	-37.5
Total program cost	$10,532.7	$7,289.5	-30.8
Program unit cost	$83.593	$140.182	67.7
Total quantities	126	52	-58.7
Acquisition cycle time (months)	100	139	39.0

The C-5 RERP technologies are mature and the basic design is stable. We did not access production maturity because the Air Force is buying commercially available items. However, in 2007, the program notified Congress that program unit costs increased over 50 percent because of rising production costs, triggering a Nunn-McCurdy unit cost increase over the critical cost growth threshold. Subsequently, DOD examined 14 options to meet its strategic airlift requirements and chose the option that would upgrade 52 aircraft, less than half originally intended. Prior to the breach, DOD planned to apply AMP and RERP to its entire fleet of C-5 aircraft. The results of an ongoing mobility capabilities requirements study, to be released in May 2009, may or may not affect the number of C-5 aircraft receiving the RERP modification.



C-5 RERP Program

Technology Maturity

The C-5 RERP's technologies are mature based on an independent technology readiness assessment conducted in October 2001.

Design Maturity

The basic design of the C-5 RERP is now complete with over 90 percent of the drawings released.

Production Maturity

We did not assess the C-5 RERP's production maturity because the Air Force is buying commercially available items. According to program officials, the program office and prime contractor have expended considerable effort in preparing the RERP for production. For example, a production readiness review was conducted, three test aircraft were produced in the system development and demonstration phase, and the lessons learned from AMP are being applied to production plans. Developmental flight testing was completed in August 2008 and developmental test and evaluation will end in December 2008.

Operational testing is expected to begin in August 2009. However, the Air Force does not plan to provide a low-rate initial production aircraft for operational testing, as recommended by the Director, Operational Test and Evaluation because one will not be available until September 2010. The program expects a 30-month delay between the first flight of the last system development and demonstration aircraft in February 2007 and the start of the installation modification of the first production aircraft in August 2009. The primary causes of the development delay were increased costs related to development efforts that caused the expansion of system development and demonstration, that is, the need to expand the test period and development issues, for example. The primary driver of the Lot 1 production award was the upward production cost pressures. In September 2007, Congress was notified of a Nunn-McCurdy unit cost increase over the critical cost growth threshold. The breach was attributable to increased development delays; budget adjustments; and production cost increases associated with engines, pylons, and reliability enhancements items, and Lockheed Martin labor cost increases. Proceeding with RERP modifications before mature production processes have been demonstrated increases the risk that the RERP may not meet the warfighter's performance and time requirements as design changes, revised production processes, and rework may be necessary.

Other Program Issues

Following the Nunn-McCurdy notification to Congress in 2007, DOD considered 14 options to meet its strategic airlift requirements covering a range of scenarios for the RERP program in three broad categories: modifying all C-5 aircraft, partially modifying the C-5 fleet, and canceling the C-5 RERP program. Based on this analysis, the Under Secretary of Defense for Acquisition, Technology and Logistics concluded that the cost to upgrade all C-5 aircraft was unaffordable and selected the option to limit RERP modifications to 52 aircraft—including 49 production aircraft (47 C-5Bs and 2 C-5Cs) and 3 system development and demonstration aircraft (2 C-5Bs and 1 C-5A). While the Air Force is expected to spend $3.4 billion less under the restructured program, ultimately, less than one-half of the aircraft will be modernized at a much higher unit cost. DOD had planned to provide AMP and RERP modifications to its entire fleet of C-5 aircraft.

DOD is currently studying its mobility capabilities requirements for the future. Study results are expected to be released in May 2009. Results of that study may or may not affect the number of C-5s that require the RERP modification.

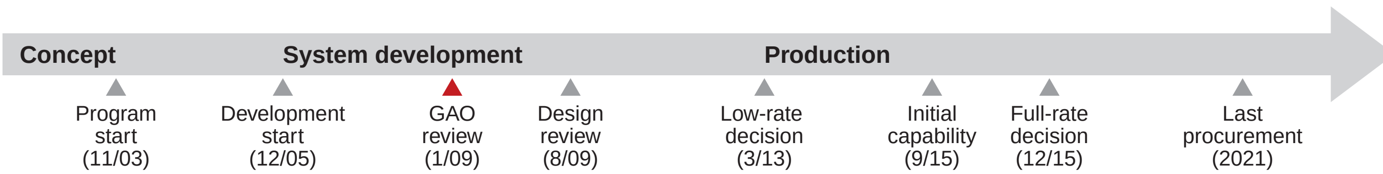
Program Office Comments

The Air Force provided technical comments to a draft of this assessment, which were incorporated as appropriate.

CH-53K Heavy Lift Replacement (HLR)

The Marine Corps' CH-53K helicopter will perform marine expeditionary heavy-lift assault transport of armored vehicles, equipment, and personnel to support distributed operations deep inland from a sea-based center of operations. The CH-53K program is expected to replace the current CH-53E helicopter with a new-build design to improve range and payload, survivability and force protection, reliability and maintainability, coordination with other assets, and total cost of ownership.

Source: © 2008 Sikorsky Aircraft Corporation.



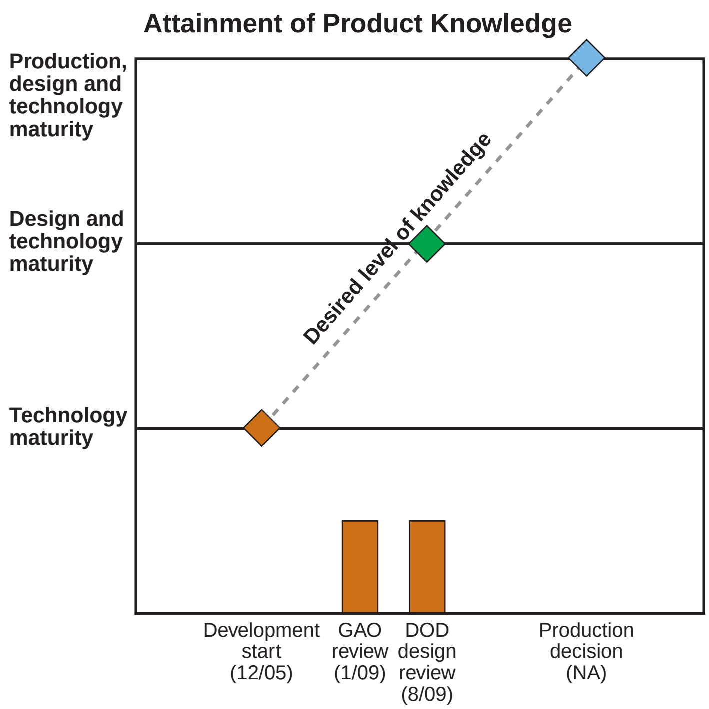
Program Essentials

Prime contractor: Sikorsky Aircraft Corporation
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $3,053.9 million
Procurement: $11,864.6 million
Total funding: $14,918.5 million
Procurement quantity: 152

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2005	Latest 12/2007	Percent change
Research and development cost	$4,228.8	$4,173.4	-1.3
Procurement cost	$11,762.3	$11,864.6	0.9
Total program cost	$15,991.1	$16,038.1	0.3
Program unit cost	$102.507	$102.808	0.3
Total quantities	156	156	0.0
Acquisition cycle time (months)	119	117	-1.7

Both of the CH-53K's current critical technologies, the main rotor blade and the main gearbox, are immature and are expected to be fully mature following the low-rate initial production decision in 2013. The program replaced a third technology, the viscoelastic lag damper, with a modified version of an existing technology. During preparations for the preliminary design review, it was discovered that maturing system engineering tasks would potentially require additional cost and time. As a result, the program eliminated noncritical requirements to contain costs and delayed the preliminary and critical design reviews and low-rate initial production decision. Due to attrition in the fleet of CH-53Es, the Marine Corps has recognized the need for fielding the CH-53Ks as soon as possible. To do so, the program plans to commence low-rate initial production concurrent with operational testing.



CH-53K Program

Technology Maturity

The two current critical technologies for the CH-53K program—the main rotor blade and the main gearbox—are immature. While the technologies are maturing on schedule, the program office does not expect them to be fully mature until completion of initial operational test and evaluation, following the CH-53K's low-rate initial production decision in 2013. The main rotor blade will be the same diameter (79 feet) and 11 percent wider than the CH-53E design. A smaller-scale (1/7th) model of the main rotor blade has demonstrated improved performance in wind tunnel tests to meet new vertical lift requirements. The actual-sized rotor blade has not been tested because appropriately sized wind tunnels do not exist. According to program officials, full scale prototypes of main gearbox components have been tested and have met or exceeded performance requirements.

The CH-53K program office removed one critical technology from the program by replacing the viscoelastic lag damper with a modified linear hydraulic damper. The modified damper will provide double the reliability of the damper on the CH-53E, but will provide only half the expected reliability of the viscoelastic lag damper.

Design Maturity

We could not assess design stability because the CH-53K program office does not collect traditional information on design drawings to manage stability. Instead, the program office assesses design stability at systems engineering and technical reviews, by reviewing and approving the relevant design baseline at the time. During preparations for the preliminary design review, the program conducted a full review of all tasks and discovered that maturing system engineering tasks would potentially require additional cost and time. As a result, the program eliminated noncritical requirements to contain costs and delayed, in sequence, the preliminary design review, the critical design review, and the low-rate initial production decision. The critical design review and design readiness review have both been delayed by 5 months, and the start of low rate initial production has been delayed by 4 months. Given these schedule challenges, the program office is placing a greater emphasis on mitigating schedule risk and increasing the efficiency of testing to put the program back on schedule.

Other Program Issues

With the current gap between required and operational CH-53Es expected to almost double in the next 5 years, the need for the deployment of the CH-53K as a replacement has increased. According to program officials, all available decommissioned CH-53E helicopters have been reclaimed while the program continues to review the condition of other nonflying assets for potential spare parts. Program officials stated that to address the operational challenges that have led to this attrition, the requirements of the CH-53K are greater than the CH-53E's thresholds for operating environment, range, and load capacity.

Currently deployed CH-53E aircraft are flying at three times the planned utilization rate. This operational pace is expected to result in higher airframe and component repair costs, including short-term fatigue repairs necessary to minimize CH-53E inventory reductions until CH-53K deliveries reach meaningful levels. The program intends to manufacture up to 29 of the 156 total helicopters (19 percent) during low-rate initial production at the same time that it is conducting initial operational testing. While concurrent testing and production may help to field the systems sooner, it could also result in greater retrofit costs if unexpected design changes are required.

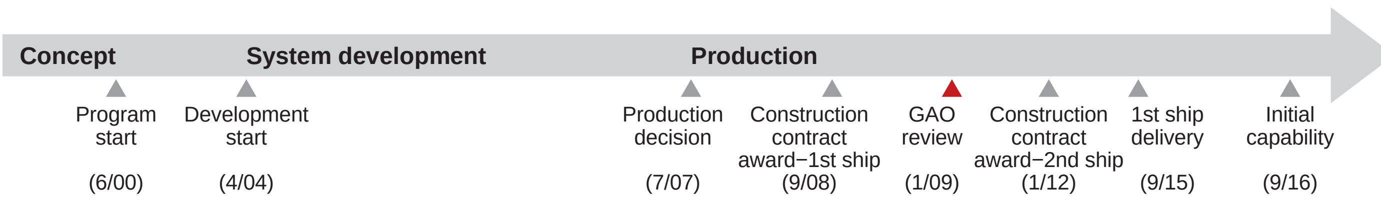
Program Office Comments

In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

CVN 21 Nuclear Aircraft Class Carrier

The Navy's CVN 21 program is developing a new class of nuclear-powered aircraft carriers that will replace USS Enterprise and the Nimitz-class. The new carriers are expected to include advanced technologies in propulsion, weapons handling, aircraft launch and recovery, and survivability designed to improve operational efficiency and enable higher sortie rates while reducing required manpower. The Navy awarded a contract for construction of the lead ship, CVN 78, in September 2008 and expects delivery of the ship by September 2015.

Source: CVN-21 Program Office 050708-D-8455H-001 Washington, D.C. (July 8, 2005) U.S. Navy graphic (released).



Program Essentials

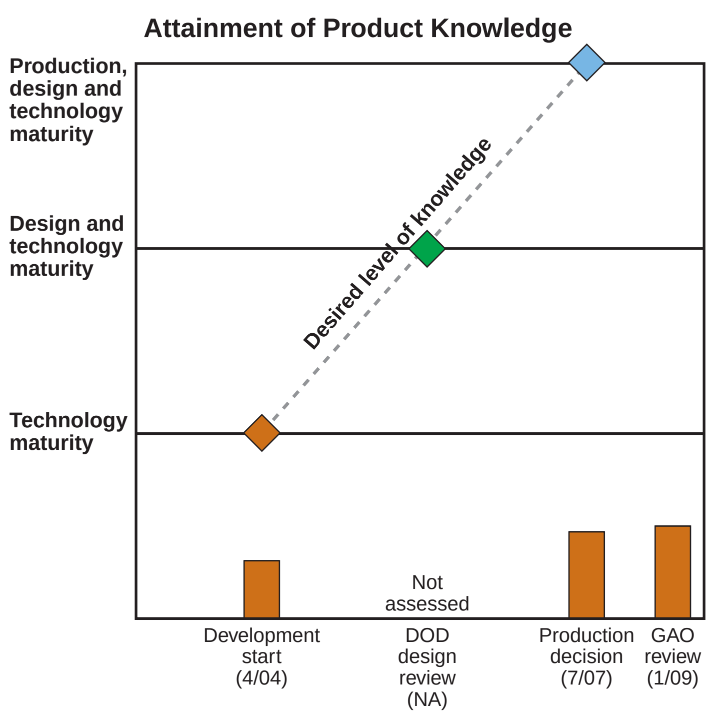
Prime contractor: Northrop Grumman Newport News
Program office: Washington, DC
Funding needed to complete:
- R&D: $1,303.4 million
- Procurement: $19,590.1 million
- Total funding: $20,893.5 million
- Procurement quantity: 2

Program Performance (fiscal year 2009 dollars in millions)

	As of 04/2004	Latest 12/2007	Percent change
Research and development cost	$4,639.4	$4,205.0	-9.4
Procurement cost	$29,720.9	$25,709.0	-13.5
Total program cost	$34,360.3	$29,913.9	-12.9
Program unit cost	$11,453.450	$9,971.308	-12.9
Total quantities	3	3	0.0
Acquisition cycle time (months)	137	149	8.8

Program costs decreased due to changes in the estimated costs for the second and third ships.

Five of 14 current critical technologies are fully mature, including the nuclear propulsion and electric plant. Five technologies are approaching maturity, while four others remain immature. Of these technologies, the development and design of the electromagnetic aircraft launch system (EMALS), the advanced arresting gear, and the dual band radar (composed of the volume search and multifunction radars) present the greatest risk to the ship's cost and schedule. Technology development challenges have already caused delays in testing and the delivery of key subsystems to the shipyard. As of July 2008, 87 percent of the design was complete and construction of a number of units located low on the ship is already complete. According to the Navy, these units account for 6-7 percent of the ship's total production hours.



CVN 21 Program

Technology Maturity

Nine of the CVN 21 program's 14 critical technologies are not yet fully mature. Of these technologies, EMALS, the advanced arresting gear, and the dual band radar present the greatest risk to the ship's cost and schedule. Problems during EMALS development have already resulted in cost growth and schedule delays. In order to meet CVN 78's delivery date, the Navy adopted a strategy that will test, produce, and ultimately install EMALS with a high degree of concurrency. In September 2008, the contractor completed the first round of high-cycle testing, gaining confidence in the performance of the generator—a source of past problems. Contractor-led integrated land-based system testing will not be complete until the end of fiscal year 2011—2-years later than estimated in December 2007. Assuming no further delays, EMALS will not demonstrate full performance of a shipboard ready system until at least 7 months after installation on CVN 78 has begun. The advanced arresting gear has completed early verification tests that proved the system's concept. Integrated land-based testing with both simulated and live aircraft has slipped by one year since last year's assessment and is now scheduled for 2010. The Navy recently postponed delivery of the arresting gear to the shipyard. Consequently, the shipbuilder will not install the gear prior to laying the flight deck—a less optimal and more costly approach to building the ship. The dual band radar—which includes the volume search and multifunction radars—is being developed as part of the DDG 1000 program. While the multifunction radar has been tested at sea, considerable testing remains for the volume search radar. Land-based tests of the volume search radar prototype will not be completed until May 2009—2 years later than planned. Upcoming land-based tests will be conducted at a lower voltage than needed to meet requirements—and without the radome (the radar's composite shield). Full power output will not be tested on a complete system until 2012. Tests of carrier-specific functionality will not conclude until shortly before shipyard delivery in 2013 leaving little time to resolve problems before ship installation.

Design Maturity

As of July 2008, 87 percent of the design was complete. However, we did not assess design stability because the Navy does not use the percentage of drawings completed as an indicator of design maturity. Instead, it measures design progress by the number of zones completed in the product model. The program has faced challenges in maintaining its design schedule due to delays in the receipt of technical information on EMALS and the advanced arresting gear; however, the Navy believes this issue has been largely resolved. The shipbuilder anticipates changes to CVN 78's design based on the results of EMALS testing.

Production Maturity

We did not assess production maturity because the shipbuilder does not use statistical process controls. Instead, it uses other processes to ensure that ship construction meets CVN 78 performance, service life, and producibility requirements. The Navy awarded a contract for CVN 78 construction in September 2008 and construction of a number of units located low in the ship is already complete. According to the Navy, one-third of the ship's units are in production, but these units only account for 6-7 percent of the ship's production hours.

Other Program Issues

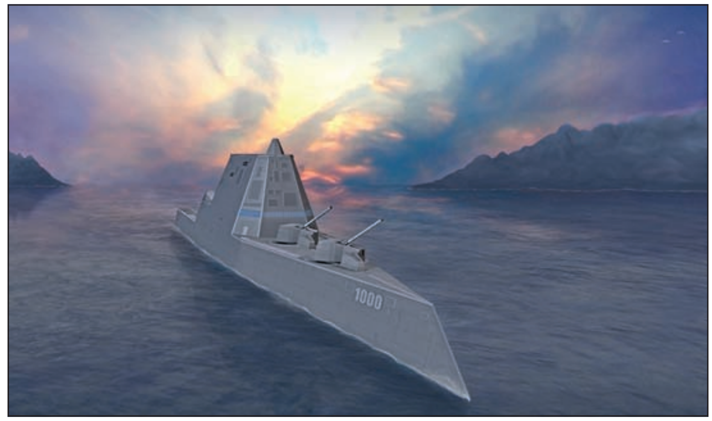
A February 2008 program assessment recommended a number of changes to the EMALS program to improve performance. The Navy re-planned the test program and changed the management approach. The CVN 21 program office is now responsible for overseeing EMALS production and ship integration, rather than the Naval Air Systems Command. In addition, EMALS will no longer be provided as government-purchased equipment. Instead, the shipbuilder will purchase EMALS, giving it a more direct role in managing the integration on CVN 78. The cost impact of this change has not been finalized.

Program Office Comments

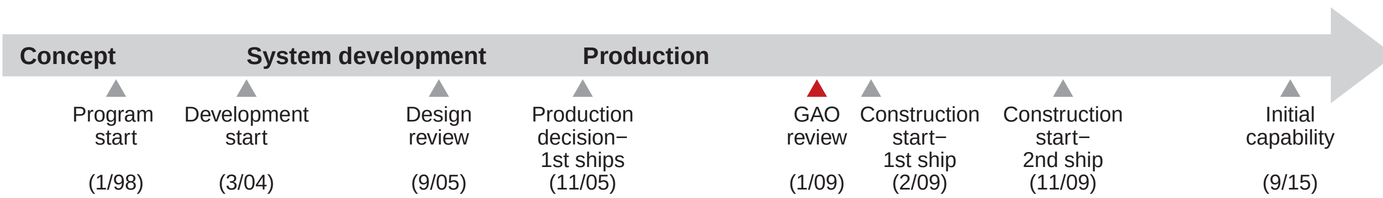
In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

DDG 1000 Destroyer

The Navy's DDG 1000 destroyer (formerly known as DD(X)) is a multimission surface ship designed to provide advanced land attack capability in support of forces ashore and contribute to U.S. military dominance in littoral operations. The program awarded contracts for detail design in August 2006 and negotiated contract modifications for construction of two lead ships in February 2008. The program will continue to mature its technologies and design as it approaches construction start, currently planned for February 2009.



Source: PEO Ships (PMS 500).



Program Essentials

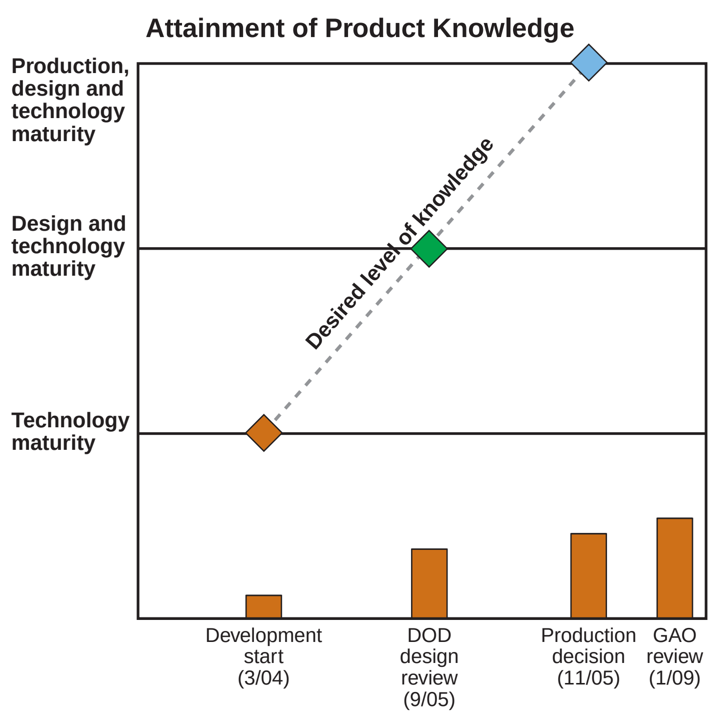
Prime contractor: BAE Systems, Bath Iron Works, Northrop Grumman Shipbuilding, Raytheon
Program office: Washington, DC
Funding needed to complete:
- R&D: $1,942.7 million
- Procurement: $11,896.4 million
- Total funding: $13,839.1 million
- Procurement quantity: 5

Program Performance (fiscal year 2009 dollars in millions)

	As of 01/1998	Latest 08/2008	Percent change
Research and development cost	$2,196.9	$9,526.9	333.7
Procurement cost	$31,412.4	$18,084.4	-42.4
Total program cost	$33,609.3	$27,611.3	-17.8
Program unit cost	$1,050.292	$3,944.473	275.6
Total quantities	32	7	-78.1
Acquisition cycle time (months)	128	212	65.6

Quantities based on the approved program estimate. Current Navy estimates plan a total quantity of three ships.

Four of 12 DDG 1000 critical technologies are fully mature, having been demonstrated in a sea environment. Six other technologies are approaching maturity, but 5 of them will not demonstrate full maturity until after installation on the ship. Two technologies remain at a lower level of maturity—the volume search radar (one of two radars that constitute the dual band radar system) and total ship computing environment. Land-based tests of the volume search radar prototype originally planned for before ship construction will not be completed until June 2009—over 2 years later. Software development for the total ship computing environment has proved challenging; the Navy certified the most recent software release before it met about half of its requirements. The Navy plans on completing 89 percent of product modeling of the ship's design prior to the start of construction.



DDG 1000 Program

Technology Maturity

Four of DDG 1000's 12 critical technologies are fully mature. Six others are approaching maturity. Practical limitations prevent the Navy from fully demonstrating all critical technologies prior to installation. The Navy does expect to demonstrate the maturity of the integrated deckhouse prior to the start of ship construction. The Navy conducted the deckhouse production readiness review in October 2008; with completion of a large-scale deckhouse test unit in November 2008. Testing of other technologies continues through ship construction start. The integrated power system will not be tested with the control system until 2011—nearly 3 years later than planned. The Navy will buy a power system intended for the third ship and use it in land-based tests. As a result, the power system will not be demonstrated until a year after production and installation on the two lead ships.

The volume search radar remains at a lower level of maturity. Land-based tests of the volume search radar prototype will not be completed until June 2009—over 2 years later than planned. Upcoming land-based tests will be conducted at a lower voltage than needed to meet requirements—and without the radome. The Navy will not demonstrate a fully capable radar at its required power output until testing of the first production unit in 2011. Partly due to delays, the volume search radar will not be installed during deckhouse construction as initially planned. Instead, installation will occur in April 2013—after the Navy has taken custody of the ship.

The Navy initially planned to develop and demonstrate all software functionality of the total ship computing environment (phased over six releases and one spiral) over 1 year before ship light-off. As a result of changes in the software development schedule, the Navy eliminated this margin. Until recently, the Navy was able to keep pace with its development schedule. However, the contractor delivered release 4 without incorporating all software system requirements and deferred work to release 5, primarily due to issues with the command and control component. Problems discovered in this release, coupled with the deferred work, may be a sign of larger issues that could disrupt the development of later releases and prevent the timely delivery of software to meet the ship's schedule.

Design Stability

The Navy aims to complete 89 percent of product modeling for the ship's 94 design zones prior to the start of construction. At the program's production readiness reviews in October 2008, the shipbuilders had completed less than 35 percent of the product model and faced challenges maintaining its design schedule. The Navy has now delayed the start of ship construction by 4 months to February 2009 in order to mature the ship's design. According to the Navy, as of January 2009, 88 percent of the zones are complete.

Other Program Issues

The Navy recently decided to reduce its quantities from seven ships to a total of three. Rather than DDG 1000, the Navy now wants to restart the procurement of the Arleigh Burke-class destroyer. According to the Navy, this is primarily because of a change in its assessment of likely future threats and in the requirements for destroyers needed to meet those threats. While eliminating follow-on ships will reduce program procurement costs by at least $10.4 billion, the costs of the three ships will likely increase. Further, the Navy still intends to spend $1.6 billion to complete research and development of DDG 1000's critical systems.

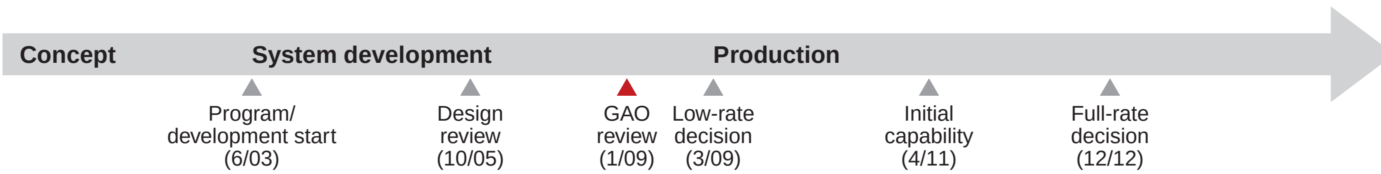
Program Office Comments

The Navy stated that the program successfully completed production readiness reviews in October 2008 and that almost 90 percent of the final Navy zone design reviews have been completed, emphasizing that no zone will start construction until the design for that zone is done. According to the Navy, DDG 1000 has a design that is much more complete, developed to a greater level of detail, and has undergone a more rigorous review than any previous ship class. Due to the long timeline required to design, develop, and deliver a Navy ship, the Navy stated that some concurrency is unavoidable to prevent obsolescence and preclude the additional cost that would be associated with stretching the timeline to allow all technologies to reach readiness levels meeting GAO best practice recommendations prior to construction. The Navy concluded that DDG-1000 has achieved the proper balance of developmental risk, schedule impact, and cost.

E-2D Advanced Hawkeye (E-2D AHE)

The Navy's E-2D AHE is an all-weather, twin-engine, carrier-based aircraft designed to extend early warning surveillance capabilities. It is the next in a series of upgrades the Navy has made to the E-2C Hawkeye platform since its first flight in 1971. The key objectives of the E-2D AHE are to improve battle space target detection and situational awareness, especially in the littorals; support Theater Air and Missile Defense; and provide improved operational availability for the radar system.

Source: Program Executive Officer, Tactical Aircraft Programs (PEO(T)).



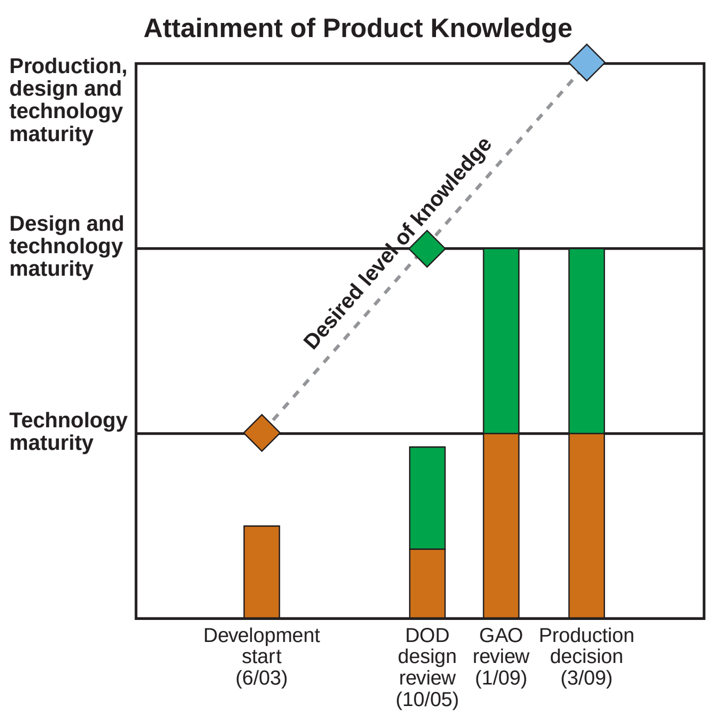
Program Essentials

Prime contractor: Northrop Grumman Corp.
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $854.3 million
Procurement: $11,634.7 million
Total funding: $12,489.0 million
Procurement quantity: 70

Program Performance (fiscal year 2009 dollars in millions)

	As of 06/2003	Latest 09/2008	Percent change
Research and development cost	$3,709.8	$3,924.0	5.8
Procurement cost	$10,538.5	$11,686.6	10.9
Total program cost	$14,248.3	$15,610.6	9.6
Program unit cost	$189.977	$208.141	9.6
Total quantities	75	75	0.0
Acquisition cycle time (months)	95	94	-1.0

All four of the E-2D AHE's critical technologies are mature. Ninety-nine percent of total estimated design drawings were releasable and the E-2D AHE design is stable. While the program has experienced growth in total expected design drawings since its critical design review in October 2005, the rate of growth has slowed considerably since our last assessment. In 2008, the program completed a production readiness review and an operational assessment in preparation for a low-rate initial production decision scheduled for March 2009. The program currently faces a 4 to 6 month delay in its flight testing schedule. The program is planning to take a series of steps to minimize the effect on the program. Program officials estimate there will be also be a 12 to 24 month delay in initial operating capability and a 20 percent increase in unit cost due to recent budget cuts.



E-2D AHE Program

Technology Maturity

According to the program office, all four of the E-2D AHE's critical technologies are mature. Three of these technologies—the rotodome antenna, power amplifier module UHF transistor, and multi-channel rotary coupler—demonstrated their maturity in the last year. The program office's technology maturity assertion is based on flight testing since August 2007. The program is currently in the process of completing a formal technology readiness assessment in preparation for a low-rate initial production decision scheduled for March 2009.

Design Maturity

Ninety-nine percent of total estimated design drawings were releasable and the E-2D AHE design is stable. While the program has experienced growth in total expected design drawings since its critical design review in October 2005, the rate of growth has slowed considerably. In the last year, the increase was approximately 8 percent compared to the 39 percent increase from 2006 to 2007. The program office expects there will be negligible additional drawing growth and all design drawings will be released by the low-rate initial production decision.

Production Maturity

The program office did not identify any critical manufacturing processes associated with the E-2D AHE, nor does the program require the contractor's major assembly site to use statistical process controls to ensure its critical processes are producing high-quality and reliable products. Instead, the program office indicated that it uses a variety of tools to assess production maturity including production readiness reviews, earned value management data, production schedules, and tool design and fabrication metrics and schedules. The program successfully completed a production readiness review in August 2008.

Other Program Issues

In early flight testing, the program experienced problems with the high power circulators, hydraulic lines, antenna power amplifier modules, and inclement weather, which has resulted in a 4 to 6 month delay in the program's flight testing schedule. As a result, the program has completed fewer test points than planned. The program is taking a series of steps to address flight testing delays, such as improving aircraft maintenance, conducting more tests per flight, and utilizing both test aircraft for mission systems testing. However, given the extent of the delays, completing flight testing according to its original schedule may not be feasible.

According to program officials, the program will experience additional delays due to budget cuts that will decrease the number of aircraft available for testing and training purposes. The budget cuts are expected to decrease the number of aircraft to be purchased in each of the first two low-rate initial production lots from three to two. According to program officials, it is likely that the budget cuts will impede the program's ability to meet its planned initial operational capability date due to the reduced number of aircraft available to perform pilot and maintenance training operations to prepare for initial deployment. Program officials estimate this reduction in two aircraft will cause a 12 to 24 month delay in initial operating capability and a 20 percent increase in the aircraft's unit cost.

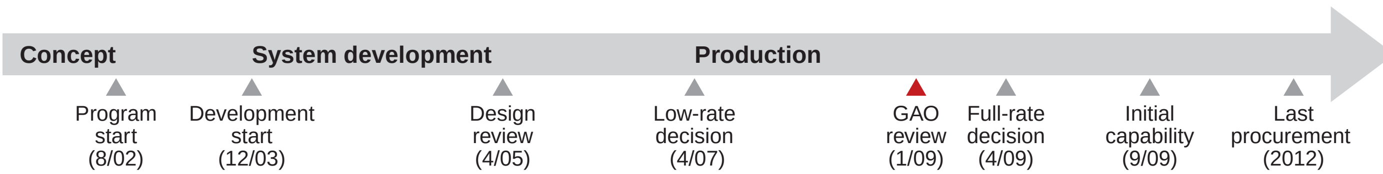
Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated as appropriate.

EA-18G

The Navy's EA-18G Growler will replace the carrier-based EA-6B and provide electronic warfare capability beginning in 2009. The EA-18G is designed to support friendly air, ground, and sea operations by suppressing enemy radar and communications. The aircraft is a combination of the new, more capable Improved Capability (ICAP) III electronic suite, the F/A-18F airframe, and other EA-18G unique capabilities. The program began operational testing in September 2008 and is scheduled to replace all carrier based Navy EA-6Bs by 2013.

Source: U.S. Navy.



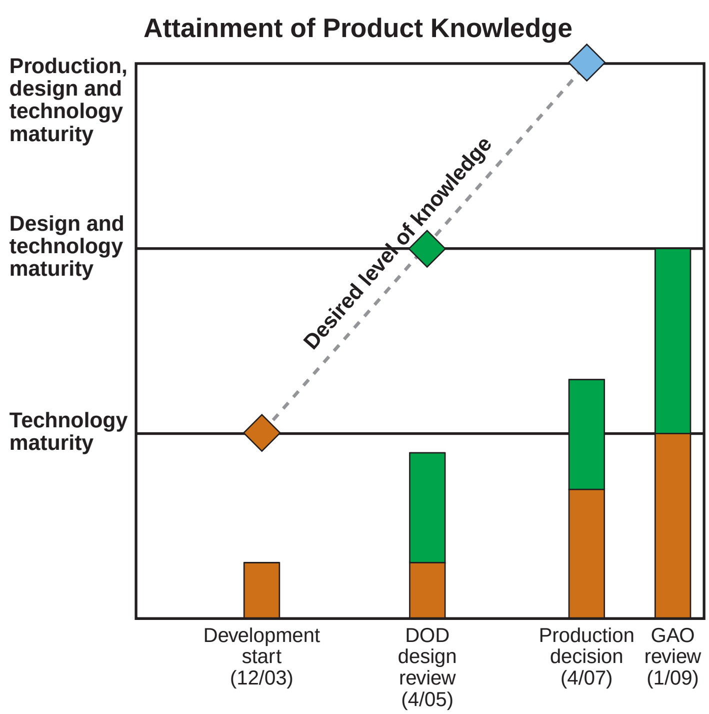
Program Essentials

Prime contractor: Boeing
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $240.4 million
- Procurement: $4,039.4 million
- Total funding: $4,279.8 million
- Procurement quantity: 54

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2003	Latest 10/2008	Percent change
Research and development cost	$1,846.5	$1,918.0	3.9
Procurement cost	$6,822.6	$6,865.3	0.6
Total program cost	$8,669.1	$9,847.0	13.6
Program unit cost	$96.323	$111.898	16.2
Total quantities	90	88	-2.2
Acquisition cycle time (months)	70	69	-1.4

The EA-18G began development in December 2003 without demonstrating that its five critical technologies were fully mature. A 2007 independent assessment reduced the number to two and judged both mature. While the design appeared stable at the time of the 2005 design review, the number of drawings has since increased. Acceptance reports for five aircraft delivered since 2007 identified several defects that are common to the production line. Additionally, an April 2008 operational assessment identified tactical display clutter, crew workload, and mission planning as high risk areas. A subsequent technical evaluation reports them as moderate to low risk. The Navy plans to buy one-third of the total production before completing operational testing, which adds retrofit risk. An updated agreement with the Air Force on airborne electronic attack support could affect the program.



Growler Program

Technology Maturity

According to a 2007 independent technology readiness assessment, the EA-18G program's two current critical technologies—the ALQ-218 receiver system and inertial measurement unit software—are mature. When the program began development in 2003, none of its then five critical technologies were fully mature.

Operational and technical assessments of the EA-18G identified issues related to critical technologies that affected its ability to meet reliability requirements and could degrade mission effectives. An April 2008 operational assessment lists tactical situation display clutter, crew workload, and mission planning as high-risk areas that affected all EA-18G critical operational issues. A September 2008 technical evaluation, used to support the operational readiness decision, reports them as presenting a moderate to low risk to operational testing. This evaluation also highlights deficiencies that will require the operator to make excessive adjustments in order to accomplish the primary or alternate mission. In addition, the report identified deficiencies that could present a severe hazard to the weapon system or personnel. For example, inadequate threat warning indications and limitations to the aircraft's flight envelope when it is carrying the ALQ-99 tactical jamming system pods with extended low-band radome could degrade mission effectiveness. The program has provided a redesigned low-band radome to the operational test community. Fixes for some of the other open deficiencies have not yet been identified.

Design Maturity

While the design of the EA-18G appeared stable at its 2005 critical design review, the total number of drawings released has increased by 87 percent. This change is due, in part, to the exclusion of drawings related to electrical, armament, and equipment installation modifications for flight test aircraft at the design review. According to the program officials, the additional drawings went through proper configuration controls and had no effect on cost and schedule. The program has redesigned the low-band radomes because legacy radomes could not handle the increased EA-18G flight envelope. The redesigned radome has been provided to the operational test community for use during testing.

Production Maturity

We could not assess production maturity because the contractor does not collect statistical process control data. The EA-18G is a derivative of the F/A-18E/F aircraft and, according to the program office, the contractor determined that the current tooling provides sufficient mold line tolerance control. Five aircraft have been delivered since 2007. Acceptance reports have identified defects that are not unique to the EA-18G but rather are common with the F/A-18E and F aircraft as well. For most of the defects, root cause investigations by the contractor are underway. The Navy still plans to buy one-third of the total production quantity prior to completing operational testing. The potential for redesign and retrofit risk remains until all capabilities are demonstrated during operational testing. The program office noted that this buy is in accordance with the approved acquisition strategy.

Other Program Issues

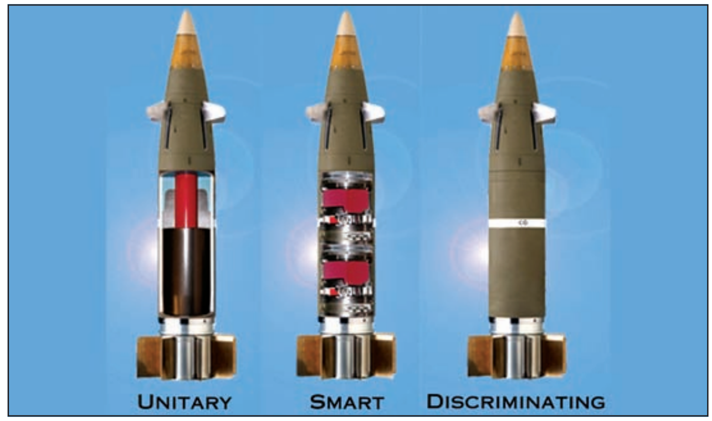
Continuation of a memorandum of agreement between the Navy and the Air Force on airborne electronic attack support could affect the number of EA-18G the Navy needs. According to program officials, the Navy's requirements are being met with the current buy of EA-18Gs. If there were a need for additional EA-18Gs, a decision to buy more should be made by April 2009 to optimize pricing and schedule. However, if additional aircraft were purchased, there would be significant personnel-related risk due to the lead time needed to train pilots and maintainers.

Program Office Comments

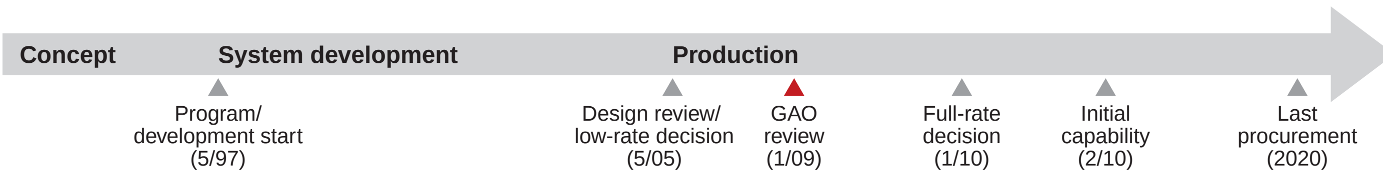
In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

Excalibur Precision Guided Extended Range Artillery Projectile

The Army's Excalibur is a family of global positioning system-based, fire-and-forget, 155 mm cannon artillery precision munitions intended to provide improved range and accuracy. The Excalibur's near-vertical angle of fall is expected to reduce collateral damage around the intended target, making it more effective in urban environments than current projectiles. The Future Combat System's Non-Line-of-Sight Cannon requires the Excalibur to meet its required range. Only the unitary variant is currently being developed.



Source: PM Excalibur.



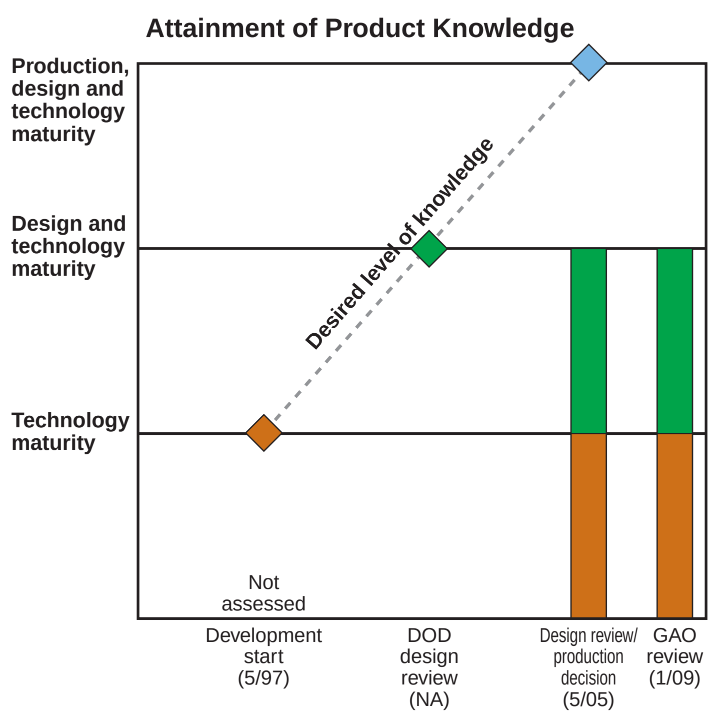
Program Essentials

Prime contractor: Raytheon
Program office: Picatinny Arsenal, NJ
Funding needed to complete:
- R&D: $125.0 million
- Procurement: $1,216.3 million
- Total funding: $1,341.3 million
- Procurement quantity: 28,728

Program Performance (fiscal year 2009 dollars in millions)

	As of 02/2003	Latest 08/2008	Percent change
Research and development cost	$739.3	$934.4	26.4
Procurement cost	$3,873.8	$1,429.5	-63.1
Total program cost	$4,613.1	$2,363.8	-48.8
Program unit cost	$.060	$.078	29.3
Total quantities	76,677	30,388	-60.3
Acquisition cycle time (months)	136	153	12.5

According to program officials, Excalibur's critical technologies were mature and its design was stable by May 2005. Since development began in 1997, the program has encountered a number of significant changes, including four major restructures, reduced production quantities, and increased unit costs. Only the unitary variant is currently being developed. This variant will be developed in three incremental blocks, which will incorporate increased capabilities over time. The Excalibur program has begun early production on Increment Ia to support an urgent early fielding requirement in Iraq for more accurate artillery that will reduce collateral damage. In September 2008, the program awarded two contracts for the development of Increment Ib projectiles.



Excalibur Program

Technology Maturity

According to the program office, all three of the unitary variant's critical technologies reached full technology maturity in May 2005 at the time of the Excalibur's design review. These technologies were the airframe, guidance system, and warhead.

Design Maturity

Excalibur's design for Block Ia-1 appears to be stable. In May 2005, Excalibur held its design review and concurrently entered production to support an urgent fielding requirement in Iraq. At the time of the design review, 750 of 790 design drawings were released. By August 2006, the number of drawings had increased by almost 20 percent to 943, all of which have been released.

Production Maturity

We could not assess Excalibur's production maturity. According to the program office, the program is taking steps to utilize statistical process control at the subsystem and component levels, but, at this point, the production processes remain largely noncontinuous and are still not conducive to using statistical process control at the system level. The program's early focus will be on areas with stable processes, consistent suppliers, and high inspection costs.

Other Program Issues

The Excalibur acquisition plan currently focuses on developing its unitary version in three incremental blocks—Ia-1, Ia-2, and Ib. In Block Ia-1, which has been made available for early fielding, the projectile would meet its requirements for lethality and accuracy in a nonjammed environment. In Block Ia-2, the projectile would be improved to meet its requirements for accuracy in a jammed environment, with extended range and increased reliability, and would be fielded with the Army's Future Combat System's Non-Line-of-Sight Cannon (NLOS-C). In Block Ib, the projectile would be improved to further increase reliability, lower unit costs, and would be available for fielding in fiscal year 2012. The other two Excalibur variants—smart and discriminating—are expected to enter system development in fiscal year 2010, although both variants are unfunded.

Excalibur was fielded in Iraq with its first use in combat in 2007. Block Ia-1 Excalibur rounds have been delivered to Army, Marine Corps, and Canadian troops in both Iraq and Afghanistan. The project reported that 90 percent of the rounds expended in combat operations fired as expected, exceeding the requirement for Increment Ia.

Block Ia-2 is currently in development. According to program officials, no production deliveries have been made yet and qualification tests are continuing. The program is experiencing technical problems working in a jammed environment. Because of these technical problems, the program has delayed initial operational test and evaluation, full-rate production, and initial operating capability by seven months. In addition, the Excalibur program continues to address compatibility issues with the Increment Ia round and the muzzle brake of the NLOS-C. According to program officials, an engineering study indicated that changes were needed in the NLOS-C to be compatible with Excalibur, but that modifying the base of the Excalibur round would help as well. The official added that the program is performing backwards compatibility testing on howitzers that plan to fire Excalibur rounds and compatibility testing on the NLOS-C. If this modification does not resolve the compatibility issue with NLOS-C, then NLOS-C will have to wait for the availability of Block Ib projectiles in 2012. The Excalibur program awarded fixed price incentive fee contracts to Alliant Techsystems and Raytheon for a planned 18-month design maturation and demonstration phase for the Block Ib round in September 2008.

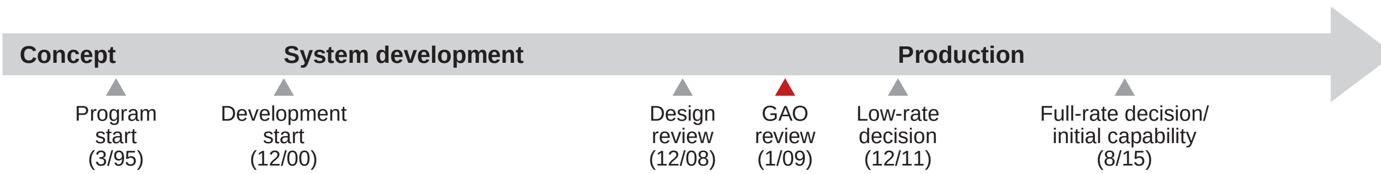
Program Office Comments

The project office concurred with a draft of this assessment.

Expeditionary Fighting Vehicle (EFV)

The Marine Corps' EFV is designed to transport troops from ships offshore to inland destinations at higher speeds and from longer distances than the Assault Amphibious Vehicle 7A—the system it is designed to replace. The EFV will have two variants—a troop carrier for 17 combat equipped Marines and 3 crew members and a command vehicle to manage combat operations. DOD restructured the program in June 2007 and awarded a follow-on development contract in July 2008 that focuses on redesigning key subsystems to improve reliability.

Source: EFV Program Office.



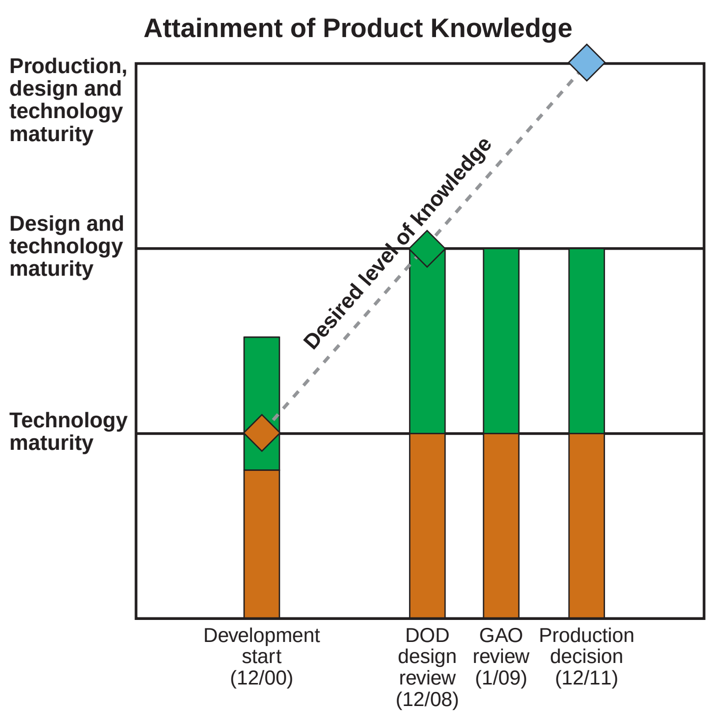
Program Essentials

Prime contractor: General Dynamics
Program office: Woodbridge, VA
Funding needed to complete:
- R&D: $1,043.6 million
- Procurement: $9,778.4 million
- Total funding: $10,889.3 million
- Procurement quantity: 573

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2000	Latest 09/2008	Percent change
Research and development cost	$1,593.5	$3,611.2	126.6
Procurement cost	$7,156.1	$9,978.1	39.4
Total program cost	$8,841.5	$13,682.5	54.8
Program unit cost	$8.626	$23.073	167.5
Total quantities	1,025	593	-42.1
Acquisition cycle time (months)	138	245	77.5

The EFV's critical technologies are mature and its design is stable. In December 2008, the program completed its critical design review with 94 percent of the system's design models releasable. The number of critical manufacturing processes will be established now that the design has been stabilized. However, production representative tooling and procedures will be used to manufacture new prototype vehicles, and program officials plan to begin collecting statistical process control data during their fabrication. The program also intends to collect and use statistical process controls during low-rate initial production and full-rate production.



EFV Program

Technology Maturity

All four of the EFV system's critical technologies are mature and have been demonstrated in a full-up system prototype under the initial development contract.

Design Maturity

The EFV's design is currently stable. The government reassessed the vehicle's design and held a critical design review in December 2008. According to program documents, 94 percent of the system's design models were releasable at that time and the contractor expected to complete the remaining models in January 2009. Prior to the critical design review, the government authorized the contractor to begin hull fabrication on the prototype vehicles being produced as a part of the extended systems development phase. According to program officials, this does not present a risk to the system because the hull design did not contribute to earlier reliability problems and therefore did not change. At the time of the critical design review, hull fabrication on the seven prototype vehicles ranged between 78 percent complete and 7 percent complete.

The EFV program has revised its approach for meeting the reliability threshold of 43.5 hours of operation before maintenance is required. The program's failure to meet this requirement in its 2006 operational assessment was the key factor behind its restructuring. According to program officials, the individual components and subsystems of the prototypes used in the 2006 operational assessment were designed to meet the reliability requirement, but now the program plans to design them to exceed it. The program hopes this will help ensure that the integrated EFV system meets the required reliability threshold.

Production Maturity

The EFV program plans to demonstrate its production processes during prototype fabrication and assess their maturity in low-rate and full-rate production. According to the program office, the prototypes will be built using production representative tooling and procedures and data will be collected on the critical manufacturing processes. However, due to the small number of prototypes being built, the program will not have those processes in statistical control. Program officials indicated that while the design-for-reliability process may change parts and materials, the majority of the manufacturing processes will remain unchanged. The number of critical manufacturing processes will be established now that the design has been stabilized. The program intends to collect data on key manufacturing processes and use statistical process controls during low-rate initial production and full-rate production. The contractor also requires suppliers that provide parts associated with key system characteristics to have their manufacturing processes in control.

Other Program Issues

In February 2007, the Navy reported a Nunn-McCurdy unit cost breach of the critical threshold. Reliability issues, optimistic cost estimating assumptions, and quantity reductions all contributed to cost increases. The program was restructured in June 2007. System development was extended and the Marine Corps modified the EFV development contract to redesign the subsystems that contributed to the reliability problems. In July 2008, the Marine Corps chose to award a follow-on development contract to build a second set of prototypes to try to resolve the reliability issues. As a result of the restructure and extension of system development, low-rate production will not begin until 2011 and full-rate production will not begin until 2015.

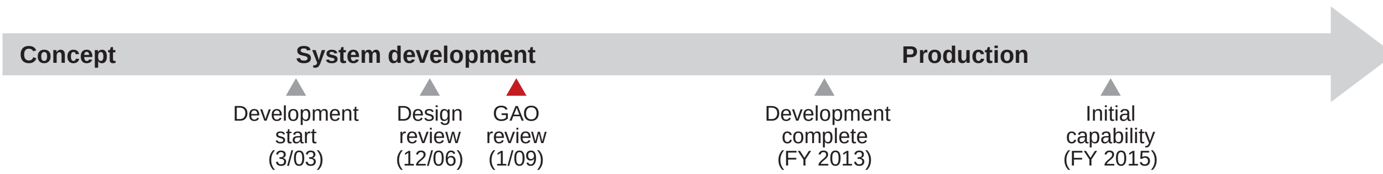
Program Office Comments

In commenting on a draft of this assessment, the Marine Corps stated that the design approved at critical design review should achieve an average reliability of 61 hours before maintenance or repair is required, based on models validated by Army reliability experts. The Marine Corps expected that 100 percent of the system design would be releasable in early January 2009.

F-22A Modernization Program

The Air Force's F-22A, originally planned to be an air superiority fighter, will have an expanded air-to-ground attack capability. It was designed with advanced features, such as stealth characteristics and supercruise to make it less detectable and capable of higher speeds. The Air Force established the F-22A modernization and improvement program in 2003 to add enhanced air-to-ground, information warfare, reconnaissance, and other capabilities and to improve the reliability and maintainability of the aircraft.

Source: U.S. Air Force, http://www.af.mil/photos/index.asp?galleryID=40&page=5.



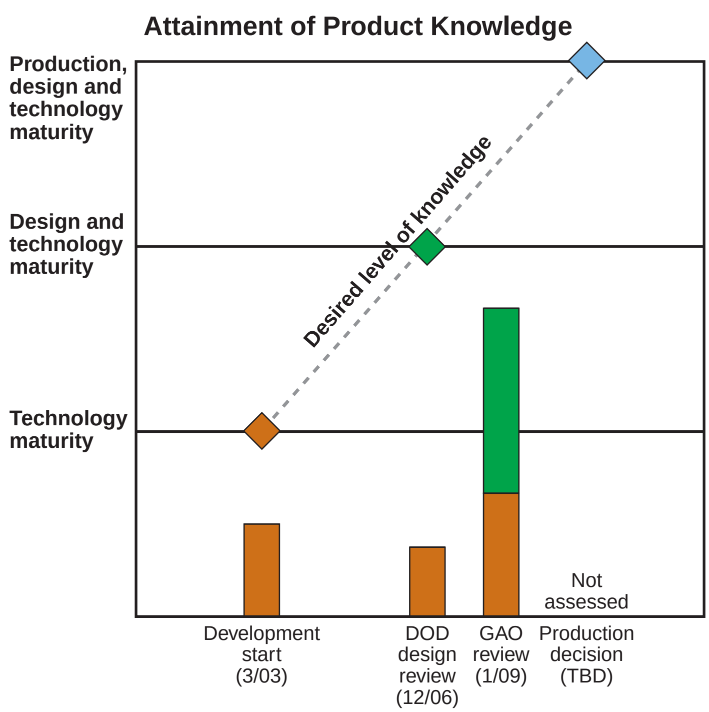
Program Essentials

Prime contractor: Lockheed Martin
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: $2,199.5 million
Procurement: $1,231.6 million
Total funding: $3,431.2 million
Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 03/2003	Latest 08/2008	Percent change
Research and development cost	$3,101.2	$4,265.1	37.5
Procurement cost	$537.4	$1,655.7	208.1
Total program cost	$3,638.6	$5,920.8	62.7
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	109	145	33.0

The Air Force planned to field enhanced F-22A capabilities in three increments to be completed in 2010. However, due to funding decreases, schedule slips, and changes in requirements and work content, the last increment will not complete development until 2013. Two of the three critical technologies are still nearing maturity and others have been deferred to future modernization efforts. The Air Force now plans to integrate additional capabilities beyond the three increments in a separate major defense acquisition program. Procurement of F-22As is due to end with the delivery of the final aircraft in 2011. However, Congress appropriated $523 million in the fiscal year 2009 Defense Appropriation Act for advance procurement for 20 F-22As. The Defense Authorization Act for Fiscal Year 2009 limited the obligation of these funds to $140 million pending a certification by the President.



F-22A Program

Technology Maturity

One of the F-22A modernization program's three critical technologies-processing memory-is mature. The two remaining technologies-stores management system and cryptography-are approaching maturity, and have been tested in a relevant environment. The maturity of these technologies has not changed in the past year. According to program officials, the current F-22 production and modernization plans do not commit to incorporating new technology into developmental increments until the underlying technologies have been tested in a relevant environment and do not commit to fielding these technologies until they have been proven in developmental and operational testing. The number and mix of technologies identified by program officials have changed since the modernization effort began, reflecting changes in program direction, priorities, and work content. Some of these have been deferred to future modernization efforts, which the Air Force plans to undertake in a separate major defense acquisition program.

Design Maturity

The design of the first increment of the F-22A modernization program appears stable, almost 2 years after its critical design review. The program office reported that all expected engineering drawings have been released. According to program officials, they did not plan to release drawings at the design review because most of the design consisted of software changes or modifications of existing hardware. Even though the design of the first increment appears stable, additional design work may be necessary, and the program still needs to demonstrate two of its critical technologies in operational environments. In addition, the program is just beginning developmental and operational testing for a number of capabilities. According to the program office, two developmental test aircraft and six operational test aircraft are being modified in fiscal years 2008 and 2009 to prove out technologies before fielding or production incorporation.

Other Program Issues

According to the F-22 program office, implementation of the modernization program's three increments has been delayed by 3 years because of numerous budget decreases and program restructurings. Since fiscal year 2002, the F-22A's modernization budget has been decreased by over $450 million. Nearly $200 million of the reductions can be attributed to program restructuring by the Air Force and the Office of the Secretary of Defense. In fiscal year 2008, the conference report accompanying the Defense Appropriation Act recommended $611 million in research and development funds for the F-22A modernization program, about $132 million less than requested by the Air Force. The 2009 Defense Appropriation Act appropriated an additional $523 million for advance procurement for 20 additional aircraft. However, the 2009 Defense Authorization Act limited the obligation of the advance procurement funds to $140 million pending a certification by the President that the procurement of F-22A fighter aircraft is in the national interest of the United States or that the termination of the production line for F-22A fighter aircraft is in the national interest of the United States.

The current F-22A multiyear procurement contract for 60 aircraft will end the program's planned procurement when the final aircraft is delivered in 2011. Program officials reported that some contractors are already beginning to cease their F-22-related efforts and would need to be replaced if additional aircraft are purchased. According to the program officials, a decision on additional F-22 purchases needs to be made by in early 2009 to avoid losing additional contractors. Further, program officials stated, it is unclear how new aircraft would affect future modernization efforts. The additional aircraft could be configured the same as previous production models (Increment 2), or they could possibly be produced as the newest increment available (Increment 3.1).

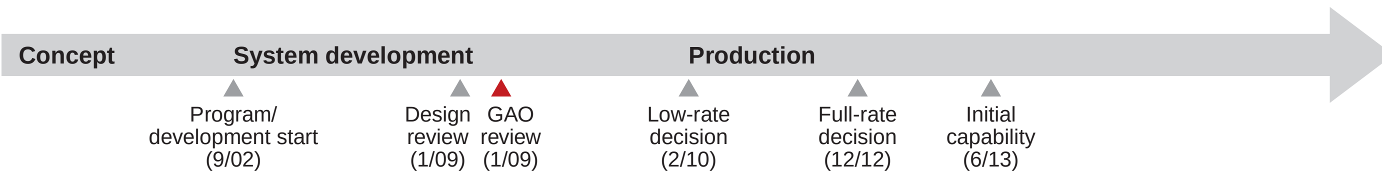
Program Office Comments

The Air Force provided technical comments, which were incorporated as appropriate.

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)

The Air Force's FAB-T will provide a family of satellite communications terminals for airborne and ground-based users. FAB-T will address current and future communications capabilities and technologies, replacing many program-unique terminals. FAB-T is being developed incrementally; the first increment will provide voice and data military satellite communications for nuclear and conventional forces as well as airborne and ground command posts, including the B-2, B-52, RC-135, E-6, and E-4 aircraft. We assessed the first increment.

Source: Boeing.



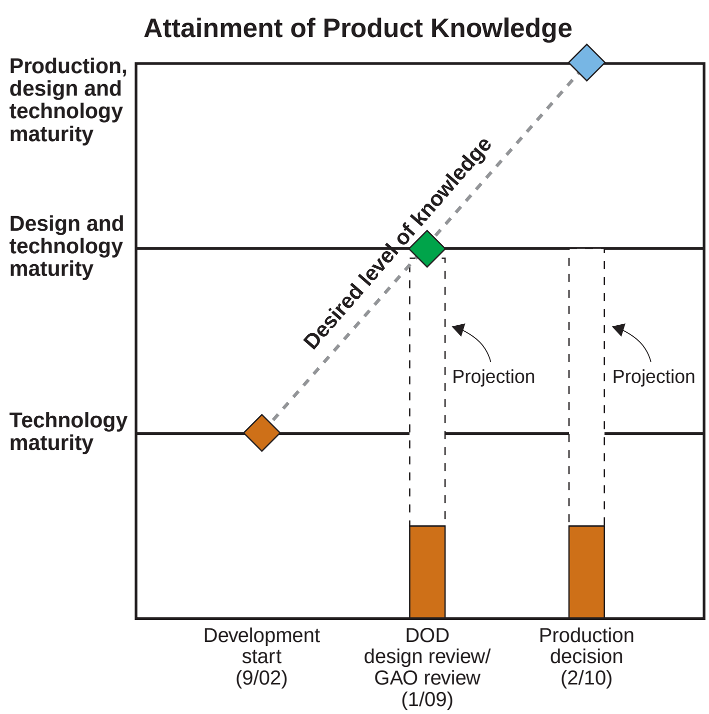
Program Essentials

Prime contractor: Boeing Company
Program office: Hanscom AFB, MA
Funding needed to complete:
- R&D: $441.6 million
- Procurement: $1,948.5 million
- Total funding: $2,390.1 million
- Procurement quantity: 197

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2006	Latest 08/2008	Percent change
Research and development cost	$1,484.6	$1,498.4	0.9
Procurement cost	$1,595.0	$1,954.7	22.6
Total program cost	$3,079.6	$3,453.0	12.1
Program unit cost	$14.257	$15.554	9.1
Total quantities	216	222	2.8
Acquisition cycle time (months)	129	129	0.0

The FAB-T program's seven critical technologies are approaching maturity and its design appears stable. The program office expects to demonstrate that all the critical technologies are mature and that the design is stable by the January 2009 design completion review. In the past year, the program incorporated two major design changes that increased the cost of the development effort. Program officials do not expect additional major design changes. In August 2008, the Undersecretary of Defense for Acquisition, Technology and Logistics delayed the start of initial operational test and evaluation and full-rate production by 1 year in order to ensure a required cryptographic module is included in testing. The FAB-T program office continues to monitor two areas—certification by the National Security Agency and software development—that could cause cost increases and schedule delays.



FAB-T Program

Technology Maturity

All seven of FAB-T's critical technologies are approaching maturity, and program officials expect they will be fully mature by January 2009. Since FAB-T was not a major defense acquisition program when it entered system development in 2002, its critical technologies were not assessed at development start.

Design Maturity

The design of the FAB-T program appears stable, based on the number of drawings that are releasable to manufacturing. As of September 2008, 85 percent of the total expected drawings were releasable and the program office expected that almost all drawings will be releasable by January 2009. Two major engineering change proposals—one related to platform and Advanced Extremely High Frequency satellite interface changes and another for modifications related to a new strategic network requirement—required design changes and increased the number of design drawings by 39 percent from the prior year. Program officials also noted that testing at the line replaceable unit level identified some places where redesign was necessary to meet requirements, however the program's June 2008 preliminary design review did not reveal any significant design issues. Program officials also noted that they have discovered multiple items in the integration process that required software changes, but they suggested these were normal for an integration of this complexity. Program officials do not expect any additional major design changes prior to the design completion review planned for January 2009.

The FAB-T program office continues to monitor two remaining risk areas—certification of FAB-T's cryptographic element by the National Security Agency (NSA) and the large amount of new software code being developed. NSA is currently performing an evaluation of the cryptographic element for low-data rate engineering models; however, NSA will not complete certifications for FAB-T until fiscal year 2011. Program officials said that while there is a potential risk of not obtaining NSA certification, they conduct regular meetings with the contractor and NSA and no major risks have surfaced to date. As a software-defined radio, 71 percent of the total lines of software code are expected to be newly developed. Since last year, the total lines of code expected in the final system have increased by over 7 percent, and software development costs have increased by approximately 6 percent. These increased costs are primarily a result of the two engineering change proposals the program has incorporated. Program officials said they expect only nominal increases to the total lines of code in the future.

Other Program Issues

According to program officials, in August 2008, the Undersecretary of Defense for Acquisition, Technology and Logistics delayed the start of initial operational testing and evaluation and full-rate production by 1 year to ensure a required cryptographic module is included in testing. As a result of this delay, low-rate initial production will be extended by 1 year. Program officials stated that this delay will have no effect on users and will not require a break in production. In addition, even though the scheduled launch of the Advanced Extremely High Frequency satellite has been delayed by 2 years, FAB-T program officials said this would have no adverse effect on FAB-T's development schedule for the first increment.

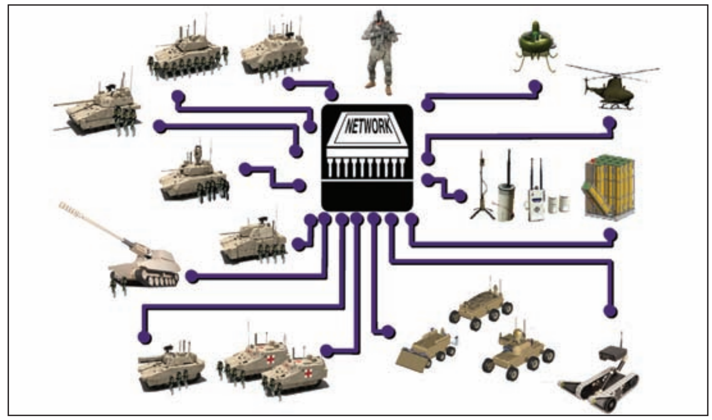
In the past year, the contract value for system development increased by over 12 percent or $120 million. Program officials primarily attributed this to FAB-T's two major design changes. Most of these increases were planned and budgeted for in 2006. Although FAB-T has experienced problems in the past with contractor performance, program officials told us that a new contractor team structure has successfully resolved many of these issues.

Agency Comments

The Air Force provided technical comments, which were incorporated as appropriate.

Future Combat System (FCS)

The Army's FCS program consists of an integrated family of advanced, networked combat and sustainment systems; unmanned ground and air vehicles; and unattended sensors and munitions intended to equip the Army's new transformational modular combat brigades. Within a system-of-systems architecture, FCS features 14 major systems and other enabling systems along with an overarching network for information superiority and survivability. We assessed the FCS program as a whole.



Source: U.S. Army.

Concept | System development | Production

Program start (5/00) · Development start (5/03) · GAO review (1/09) · Milestone review (8/09) · Design review (4/11) · Low-rate decision (4/13) · Initial capability (6/15) · Full-rate decision (2/17) · Last procurement (TBD)

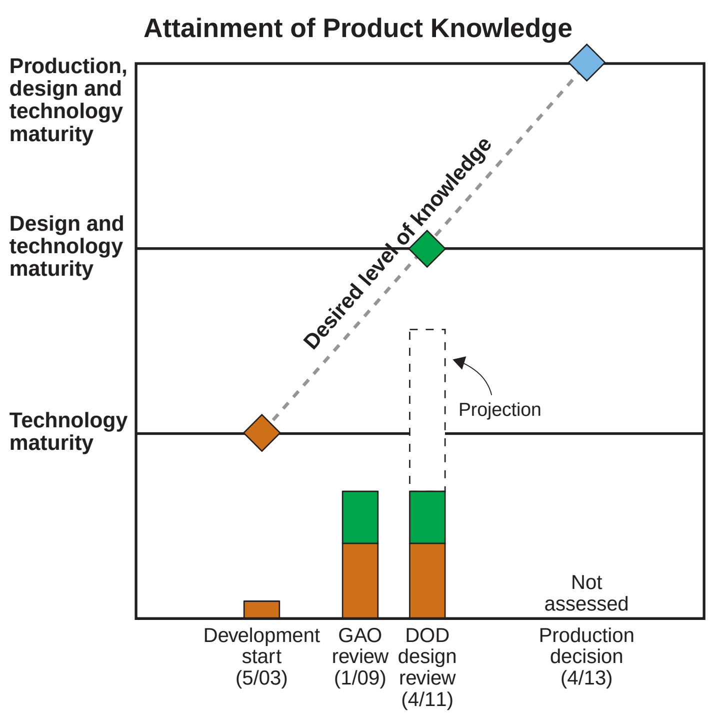
Program Essentials

Prime contractor: Boeing
Program office: Hazelwood, MO
Funding needed to complete:
R&D: $13,506.6 million
Procurement: $100,080.2 million
Total funding: $114,321.3 million
Procurement quantity: 15

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2003	Latest 12/2007	Percent change
Research and development cost	$20,886.2	$28,835.2	38.1
Procurement cost	$68,197.6	$100,160.9	46.9
Total program cost	$89,776.1	$129,730.6	44.5
Program unit cost	$5,985.076	$8,648.704	44.5
Total quantities	15	15	0.0
Acquisition cycle time (months)	91	147	61.5

According to Army officials, all 44 FCS critical technologies are expected to approach maturity this year and be demonstrated in a relevant environment by the time DOD conducts a milestone review of the program later in 2009. All FCS critical technologies may not be fully mature until the production decision. The Army has released a number of design drawings of systems that are candidates for early fielding, but there is a significant chance that designs for other systems will change. The Army began spending procurement money on FCS this year to build early prototypes of the Non-Line-of-Sight Cannon and to procure long-lead items for systems scheduled for early fielding. Last year, DOD instructed the Army to develop an incremental development approach for FCS. Details of the approach were not available, so the implications for design and production are unknown.



FCS Program

Technology Maturity

Of the FCS program's 44 critical technologies, 3 are fully mature and 27 are nearing maturity. Army officials expect to demonstrate the remaining 14 technologies in relevant environments through various tests by early 2009, in time for DOD to conduct a milestone review of the FCS program later in 2009. In the fiscal year 2007 DOD authorization act, Congress required DOD to conduct this review to determine whether and how the program will continue. All FCS critical technologies may not be fully mature until the production decision in 2013.

Since 2003, the Army has not advanced the maturity of 11 critical technologies. Two others, which are central to the Army's plans to replace armor with superior information, are now rated less mature than when the FCS program began. The Army is developing both technologies, Warfighter Information Network—Tactical and Joint Tactical Radio System, outside the FCS program. Army officials have not yet resolved requirements issues between FCS and these systems. Consequently, the Army will use engineering development versions of the Joint Tactical Radio System for testing to inform near-term production decisions.

Design Maturity

The Army has tentatively scheduled a system-of-systems preliminary design review for FCS in May 2009 and a critical design review in April 2011. At the critical design review, the Army expects to have completed 90 percent of FCS design drawings. FCS contractors have released some design drawings for a small number of systems that are candidates for early fielding as spinouts, including unattended sensors, the Non-Line-of-Sight Launch System, and various communications equipment. Contractors have also released some design drawings for an early production version of the Non-Line-of-Sight Cannon (NLOS-C). These vehicles are being built to satisfy a congressional mandate for their early fielding.

The Army is still refining many detailed FCS requirements, creating a potential for additional design changes. FCS must interoperate with at least 50 complementary systems to meet performance objectives. However, many of these systems are in development, and in some cases FCS requirements were not adequately defined for these systems. If those complementary systems are not able to accommodate additional FCS requirements, then FCS may need to change its design or sacrifice capabilities.

Production Maturity

Production of core FCS equipment is not scheduled to begin until 2013. However, the Army plans to make significant production commitments for the NLOS-C and a number of spinout systems before that date. Contract awards are scheduled for the early version of NLOS-C in January 2009 and a production decision on the first increment of spinout items is expected in late 2009.

Other Program Issues

After almost 6 years of development, the Army has spent more than half its planned development funds for FCS but will have only reached preliminary design and will only be approaching the best practice standard for the start of system development. At the same time, the Army plans to make significant investments in the production of FCS spinout, core, and NLOS-C systems before the critical design review. During the congressionally-required milestone review to be conducted later in 2009, DOD is expected to consider such factors as it determines whether and how to proceed with FCS development. DOD has already instructed the Army to prepare an alternative acquisition strategy that would involve an incremental development approach, but the details of that approach were not available in time for this report.

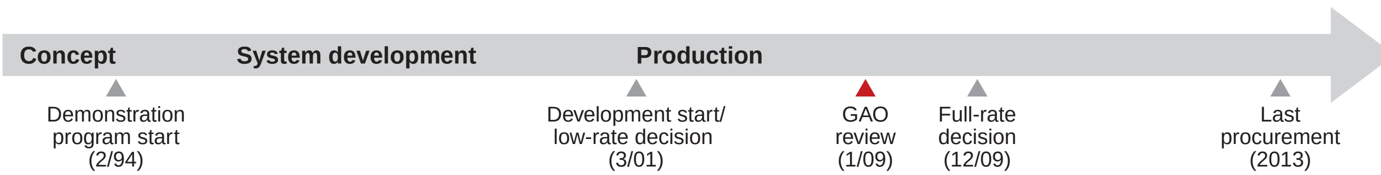
Program Office Comments

In commenting on a draft of this report, the Army stated that FCS has taken an approach that focuses on risk mitigation and a flexible architecture, which enables adaption to changes in technology and priorities over time. FCS's flexible architecture has enabled a refocusing of the spinouts from heavy brigades to infantry brigades enabling soldiers to benefit from FCS technology as soon as possible. Because of the significant amount of new technology development and the emphasis on laying a good, flexible architecture foundation, development effort/costs may not follow typical expenditure rates as other projects, and a larger percentage will be needed in the early stages of the program.

Global Hawk Unmanned Aircraft System

The Air Force's Global Hawk system is a high-altitude, long-endurance unmanned aircraft with integrated sensors and ground stations providing intelligence, surveillance, and reconnaissance capabilities. After a successful technology demonstration, the system entered development and limited production in March 2001. The acquisition program has been restructured several times. The current plan acquires 7 aircraft similar to the original demonstrators (the RQ-4A) and 47 of a larger and more capable model (the RQ-4B).

Source: Northrop Grumman Corp.



Program Essentials

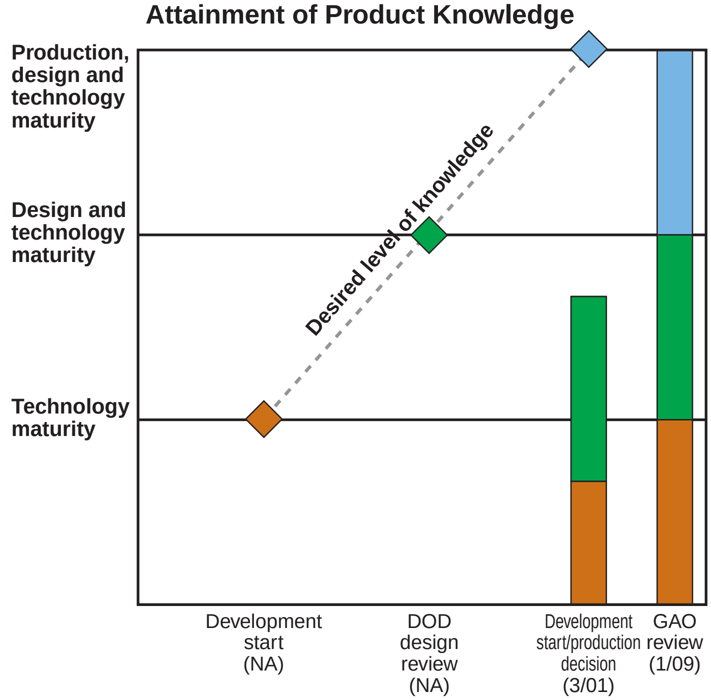
Prime contractor: Northrop Grumman Corporation
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $1,290.3 million
- Procurement: $3,421.6 million
- Total funding: $4,712.0 million
- Procurement quantity: 25

Program Performance (fiscal year 2009 dollars in millions)

	As of 03/2001	Latest 09/2008	Percent change
Research and development cost	$1,006.1	$3,657.5	263.5
Procurement cost	$4,171.4	$5,929.7	42.2
Total program cost	$5,208.1	$9,699.4	86.2
Program unit cost	$82.668	$179.618	117.3
Total quantities	63	54	-14.3
Acquisition cycle time (months)	55	TBD	NA

RQ-4A production is complete and RQ-4B aircraft are currently in production. Key technologies are mature but integration and testing is not complete. The basic airframe design is stable and the program office reports that the airframe production processes are mature. Development and operational testing to verify the design and ensure performance meets warfighter requirements has been delayed nearly 3 years due to hardware and software problems. Problems found during testing could increase costs and affect future production. Extended development times, engineering changes, production cost increases, and a reduction in quantity have contributed to a more than doubling of unit costs since the start of development in March 2001.

Attainment of Product Knowledge



Global Hawk Program

Technology Maturity

Critical technologies on the RQ-4B are mature, including the two key capabilities required for the larger aircraft—the advanced signals intelligence payload and multiple platform-radar technology insertion program. However, significant integration and testing to ensure technologies perform as intended is planned over the next year and a half. The first flight of a RQ-4B equipped with the signals intelligence payload occurred in September 2008 and development and operational testing is expected to continue through October 2009. Development of the advanced radar has experienced delays. It has flown on a surrogate platform similar to the Global Hawk. Development testing on the advanced radar RQ-4B is planned to start in May 2009 with operational testing starting by November 2010.

Design Maturity

The RQ-4B basic airframe design is now stable with all its engineering drawings released. During the first year of production, however, frequent and substantive engineering changes increased development and airframe costs and delayed delivery and testing schedules. Differences between the two aircraft models were much more extensive and complex than anticipated.

Production Maturity

The program office reports that the manfuacturing processes for the airframe are fully mature and in statistical control. Production of the smaller RQ-4A (block 10) aircraft completed in August 2006 with delivery of the seventh unit. The RQ-4B aircraft is being produced in three configurations. Block 20 aircraft are equipped with an enhanced imagery intelligence payload, block 30 aircraft have both imagery and signals intelligence payloads, and block 40 aircraft will have the advanced radar surveillance capability only. All six block 20 aircraft have been produced. Production continues on block 30 and block 40 aircraft, and 29 total aircraft have been procured through fiscal year 2008. The first block 30 aircraft was delivered to the Air Force in November 2007 and delivery of the first block 40 aircraft is projected in July 2010.

Other Program Issues

The Global Hawk system continues to provide intelligence, surveillance and reconnaissance in support of military operations in the Middle East with over 20,000 combat hours as of late 2008. The technology demonstrator version first deployed in November 2001 with the RQ-4A aircraft following in January 2006. The Global Hawk airframe was also recently selected as the winner in the Navy's competition for the Broad Area Maritime Surveillance program.

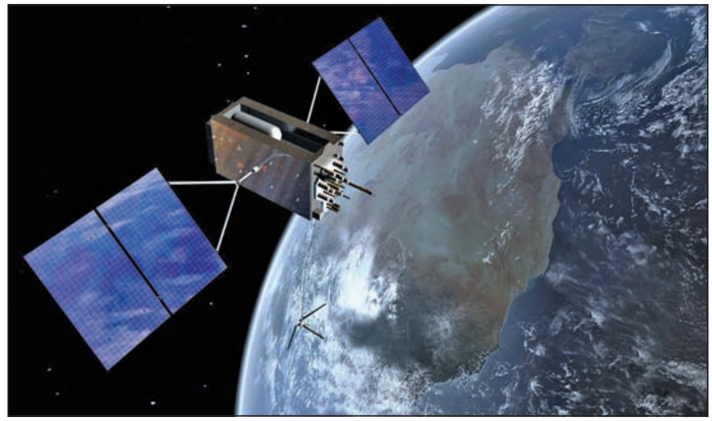
We have previously reported significant cost, schedule, and performance problems for the Global Hawk program. The program has been rebaselined three times. Extended development times, engineering changes, production cost increases, and a reduction in quantity have contributed to a more than doubling of unit costs since the start of development in March 2001. Delays in the schedules for integrating, testing, and fielding new capabilities could drive additional cost growth and increase the risk that warfighter requirements may not be met. Operational tests to verify that the basic RQ-4B design works as intended are now planned to be completed in October 2009—a delay approaching 3 years. By that time the Air Force expects to have purchased more than three-fifths of the total program quantities. Any problems discovered in testing could require changes in design and manufacturing, and could result in higher costs and further delays in deliveries to the warfighter.

Program Office Comments

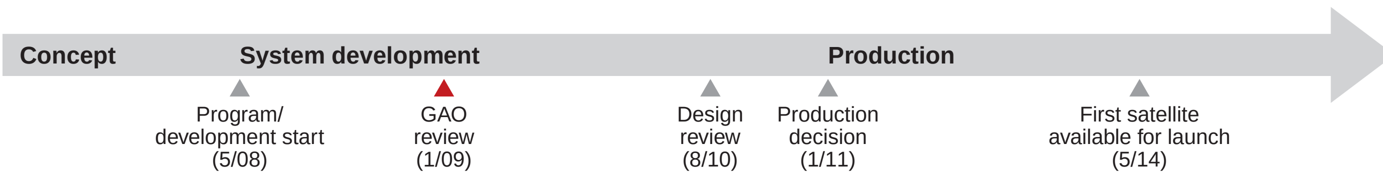
The Air Force stated that the Global Hawk program made significant strides in program execution while reducing program risk. RQ-4A aircraft have amassed over 20,000 combat flight hours demonstrating its operational utility. The larger and more capable RQ-4B aircraft with its enhanced integrated sensor completed development testing and an Operational Assessment (OA). The advanced signals sensor completed testing and an OA on a surrogate aircraft, and was integrated into and completed initial testing on the RQ-4B. The advanced radar continued development testing on a surrogate aircraft as the program prepares for integrated sensor/RQ-4B testing in 2009. Major challenges in 2009 include: preparing for and executing Block 20/30 IOT&E, software production, Block 40/MP-RTIP integration and initial testing, and deploying and sustaining operational aircraft.

Global Positioning Systems Block IIIA

GPS is an Air Force-led joint program with the Army, Navy, Department of Transportation, National Geospatial-Intelligence Agency, United Kingdom, and Australia. GPS III is the next generation of satellites. They are expected to provide enhanced capabilities, including a new signal for civilian users, anti-jam capabilities, and compatibility with the European Galileo satellite navigation system signal. GPS III will provide capabilities in three increments: GPS IIIA, IIIB, and IIIC. We assessed GPS IIIA, the first of these increments.



Source: GPS Wing.



Program Essentials

Prime contractor: Lockheed Martin
Program office: El Segundo, CA
Funding needed to complete:
- R&D: $1,825.8 million
- Procurement: $1,784.1 million
- Total funding: $3,610.0 million
- Procurement quantity: 6

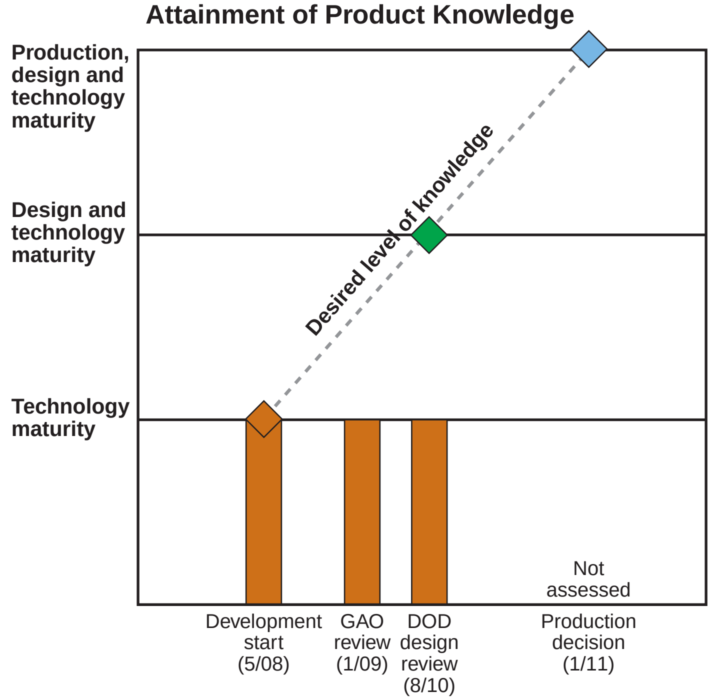
Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2008	Latest 06/2008	Percent change
Research and development cost	$2,438.0	$2,438.0	0.0
Procurement cost	$1,368.8	$1,368.8	0.0
Total program cost	$3,806.9	$3,806.9	0.0
Program unit cost	$475.862	$475.862	0.0
Total quantities	8	8	0.0
Acquisition cycle time (months)	NA	NA	NA

We could not calculate acquisition cycle times for GPS IIIA because initial operational capability will not occur until GPS IIIC satellites are fielded.

In May 2008, the GPS IIIA program began system development and awarded a contract for the development and production of eight satellites. According to the program office, the five critical technologies for the GPS IIIA are mature. The program is pursuing an incremental acquisition approach aimed at reducing cost and schedule risk by delivering capabilities to the warfighter over a period of time. The satellites are to be built using primarily heritage and commercial hardware. Because this program is in the early stages, design stability or production maturity could not be assessed. The program plans to conduct its critical design review in 2010. In addition, the new GPS IIIA contractor, which is different than the contractor for Block IIF, is still assembling the workforce needed to implement the program.

Attainment of Product Knowledge



GPS IIIA Program

Technology Maturity

According to the program office, the five GPS IIIA critical technologies—space-qualified atomic frequency standards, 28 percent efficient solar cell, radiation hardened data processor, radiation hardened field programmable gate array, and transponders—are mature.

Design Maturity

Since the GPS IIIA program is in the early stages of development, we did not assess design stability. Unlike the GPS Block IIF program, we will be able to assess the design stability of the GPS IIIA as it approaches its critical design review. According to the program office, under the GPS IIIA contract, the contractor will be required to provide design drawings to the program office for review, unlike under the contract for the current GPS Block IIF program.

Other Program Issues

Prior to the start of system development, a program office assessment determined that attempting to deliver all desired GPS III capabilities in a single block would be risky and potentially cost-prohibitive. It could also jeopardize the availability of the GPS signal to users. As a result, the program developed an acquisition strategy that would deliver capabilities in increments. Each GPS III increment is to develop satellites of increasing capabilities. The program plans to acquire 8 GPS IIIA satellites, which will transmit a new signal for civilian users and increase military signal power to provide anti-jam capabilities; 8 GPS IIIB satellites, which will provide the ability to support near real-time command and control and a high-power military code signal; and 16 GPS IIIC satellites, which will provide the regional high-power military code signal that will be demonstrated in GPS IIIB. The program plans to launch the first GPS IIIA satellite in 2014—72 months after contract award.

The GPS III program separated the acquisition of the ground segment from the space segment. However, it is also using an incremental development approach for the ground segment to help ensure that the capabilities to control and operate the satellites are available when needed.

Despite the planned launches of 14 GPS satellites before 2013, the program office continues to be concerned about a possible gap in GPS capabilities because of the the age and health of the GPS satellites currently on orbit. According to the program office, the 6-month delay in the start of the GPS IIIA program added to the risk of a capability gap. In addition, the new GPS IIIA contractor will have to assemble a workforce to implement the program from the ground up since it is not the incumbent currently building the Block IIF satellites.

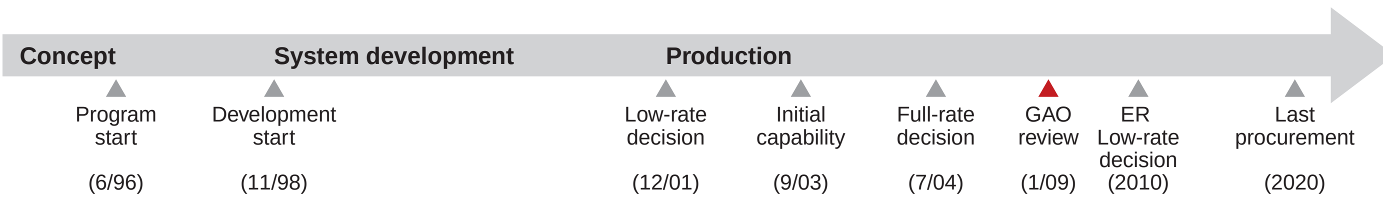
Program Office Comments

In responding to a draft of this assessment, the program office provided technical comments, which we included as appropriate.

Joint Air-to-Surface Standoff Missile (JASSM)

JASSM is a long-range Air Force air-to-ground precision missile that is able to strike targets from a variety of aircraft, including the B-1, B-2, B-52, and F-16. The Air Force plans for the JASSM Extended Range (ER) variant to add greater range capability to the baseline missile. According to the program office, the baseline JASSM and the ER variant share approximately 70 percent commonality in components. We assessed both variants.

Source: 676th Armament Systems Squadron/JASSM Program Office, approved under 96 ABW/PA #08-07-08-364.



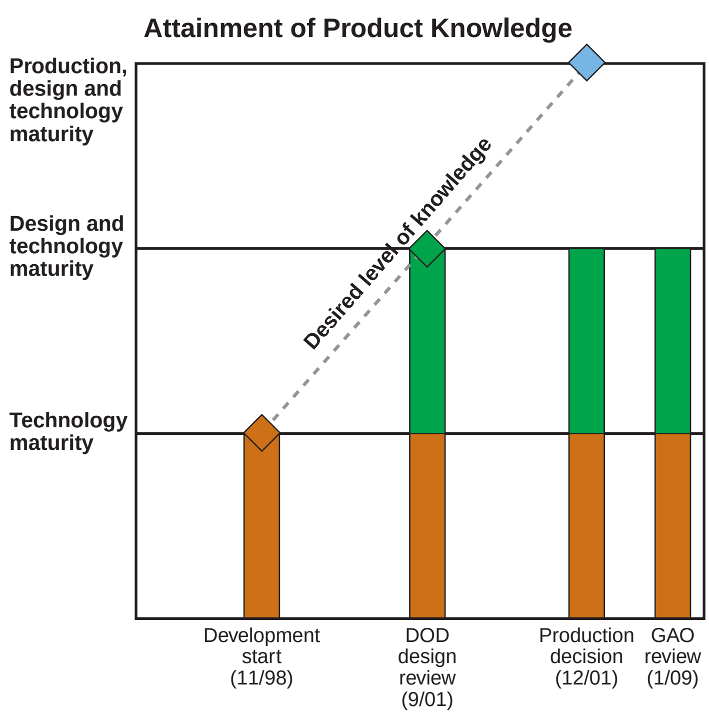
Program Essentials

Prime contractor: Lockheed Martin
Program office: Ft. Walton Beach, FL
Funding needed to complete:
R&D: $12.8 million
Procurement: $3,624.7 million
Total funding: $3,637.5 million
Procurement quantity: 3,843

Program Performance (fiscal year 2009 dollars in millions)

	As of 11/1998	Latest 12/2007	Percent change
Research and development cost	$985.1	$1,304.4	32.4
Procurement cost	$1,228.2	$4,407.6	258.9
Total program cost	$2,236.8	$5,712.0	155.4
Program unit cost	$.906	$1.141	25.9
Total quantities	2,469	5,006	102.8
Acquisition cycle time (months)	75	87	16.0

The baseline JASSM entered production in 2001. JASSM-ER development work is continuing and a production decision is scheduled for fiscal year 2010. Both the JASSM baseline and the JASSM-ER have the same three critical technologies, and the program office indicates that all three are mature. However, the JASSM program has a history of cost growth and poor missile reliability which contributed to a Nunn-McCurdy unit cost breach of the critical cost growth threshold. The Under Secretary of Defense for Acquisition, Technology and Logistics certified a restructured JASSM program in May 2008. The restructured program consists of two separable increments, the JASSM baseline increment and the JASSM-ER increment. Each increment has separate milestone decision reviews and budget lines.



JASSM Program

Technology Maturity

The JASSM program identified the same three critical technologies for both the baseline and ER variants—composite materials, global positioning system anti-spoofing receiver module, and stealth/signature reduction—and indicated all three are mature.

Design Maturity

The JASSM program will not achieve design stability until it can demonstrate that the missile can perform reliably. According to the program, all of the design drawings have been released, however the program office did not provide data on the number of drawings because the government is not acquiring drawings as a contract deliverable. According to the Program Office, the contractor has total system performance responsibility and guarantees the missile performance.

Following the 2007 Nunn-McCurdy unit cost breach of the critical cost growth threshold, the JASSM program office conducted a series of ground and flight tests. Fourteen out of 16 flight tests were successful. The successful ground and flight test results contributed to the Under Secretary of Defense for Acquisition, Technology and Logistics certification of a restructured JASSM program. The JASSM program has implemented plans to address reliability problems and missile procurements beyond Lot 7 are contingent upon continued demonstrations of improved reliability. September 2008 flight tests for both the baseline JASSM and the JASSM-ER were successful. The Under Secretary of Defense for Acquisition, Technology and Logistics has directed the Air Force to conduct a Defense Acquisition Board meeting prior to the anticipated Lot 8 contract award to review the missile and its progress on the reliability growth curve.

Production Maturity

We could not assess production maturity because the program does not collect statistical process control data. The program office stated that the contractor collects limited statistical process control data from its vendors, but it does not formally report the data to the Air Force under JASSM's contract terms. The program office stated it reviews production data during monthly program management reviews.

The Air Force has noted that previous independent reviews found reliability issues primarily driven by supplier quality control problems. However, program officials believe that none of the manufacturing processes that affect critical system characteristics are currently a problem. Additionally, the manufacturer now tracks suppliers' performance in the delivery and performance of various components and subassemblies of the JASSM.

Other Program Issues

The Air Force has 1053 missiles on contract (Lots 1-7) including 111 baseline missiles that were put on contract in June 2008 for $107 million; 779 have been delivered to date. Integrated testing is ongoing for the ER variant and low-rate initial production is scheduled to begin in 2010. The program office has scheduled 16 initial operational test and evaluation events to be conducted prior to the start of ER variant deliveries in 2011.

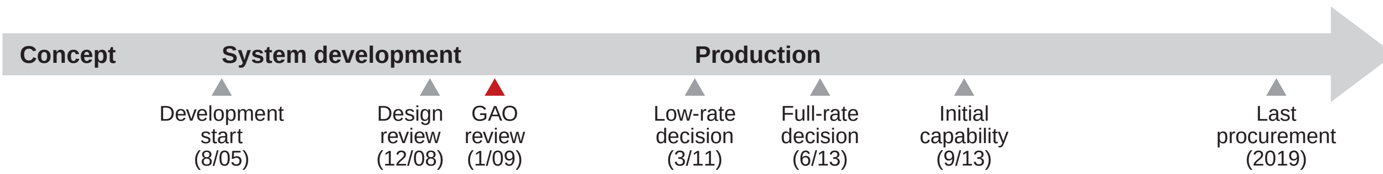
Program Office Comments

In commenting on a draft of this assessment, the Air Force stated that the government has assumed an increased role in configuration management oversight. In addition, increased manpower will be provided to review and improve subcontractor production and quality assurance practices. The Air Force is concerned about the manufacture of the current fuze and program resources have been devoted to increasing production processes and quality. Overall missile reliability will be demonstrated through lot-based flight tests, with 50+ flights scheduled for the next 2 years. The JASSM-ER program has successfully completed four flight tests and will continue its Integrated Test period in 2009 to support an Operational Assessment and a 2010 low-rate initial production milestone decision. Technical comments were also provided and incorporated as appropriate.

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Army's JLENS is designed to provide over-the-horizon detection and tracking of land attack cruise missiles and other targets. The Army is developing JLENS in two spirals. Spiral 1 is complete and served as a test bed to demonstrate initial concept. Spiral 2 consists of two aerostats with advanced sensors for surveillance and tracking as well as mobile mooring stations, communication payloads, and processing stations. JLENS provides surveillance and engagement support to other systems, such as PAC-3 and MEADS. We assessed Spiral 2.

Source: JLENS Product Office.



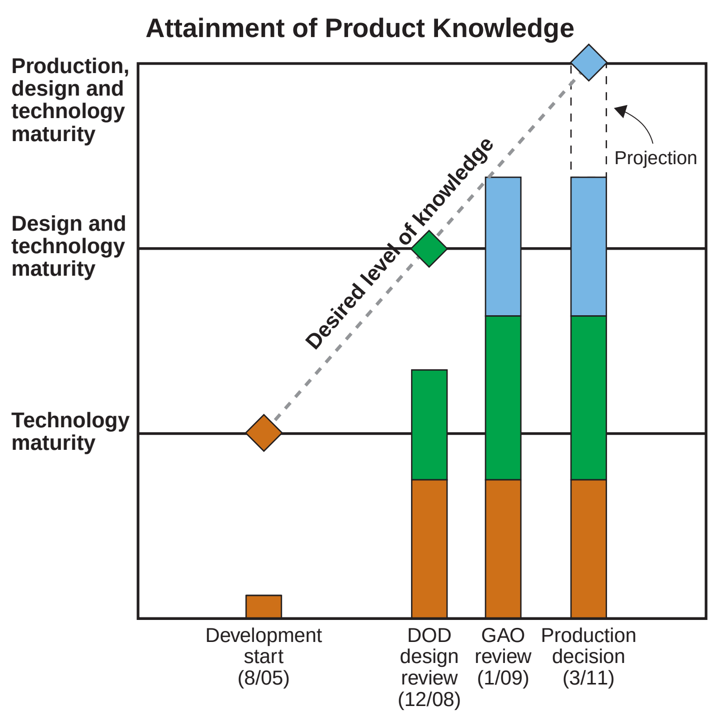
Program Essentials

Prime contractor: Raytheon
Program office: Huntsville, AL
Funding needed to complete:
R&D: $1,139.3 million
Procurement: $4,660.6 million
Total funding: $5,874.1 million
Procurement quantity: 14

Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2005	Latest 12/2007	Percent change
Research and development cost	$1,936.8	$1,965.6	1.5
Procurement cost	$4,431.6	$4,660.6	5.2
Total program cost	$6,437.8	$6,700.3	4.1
Program unit cost	$402.361	$418.771	4.1
Total quantities	16	16	0.0
Acquisition cycle time (months)	97	97	0.0

The program began development in August 2005 with one of its five critical technologies mature. The program has reduced the number of technologies from five to four. Two are mature, while two are approaching maturity. All technologies are expected to be mature in late 2010. Although the program released 88 percent of its engineering drawings in December 2008 at critical design review, risks for redesign remain until technologies demonstrate full maturity. The synchronization of JLENS development with the Army's effort to integrate the program with its Air and Integrated Missile Defense (IAMD) program also poses a risk to the program's schedule.



JLENS Program

Technology Maturity

JLENS entered system development in August 2005 with only one of its five critical technologies mature. Since that time, the program has combined two of their critical technologies, the communications payload and the processing group, into one critical technology called the communications processing group. The communications processing group, which includes radios and fiber optic equipment and also serves as the JLENS operations center, has reached full maturity, along with the platform, which includes the aerostat, mobile mooring station, power and fiber optic data transfer tethers, and ground support equipment. Both sensors, the fire control radar and the surveillance radar, have not yet reached maturity. The program expects to demonstrate these technologies by late 2010.

According to program officials, JLENS development predominately requires integration of existing technologies, and therefore all have been demonstrated as mature. However, components of the JLENS platform and the two sensors will require demonstration in the JLENS operational environment.

While many of the JLENS sensor technologies have legacy components, key hardware that proves functionality, such as the surveillance radar's element measurement system that provides data for signal processing, have yet to be demonstrated in the size and weight needed for integration on the aerostat. Tests to characterize and integrate the fire control radar and surveillance radar components are currently being conducted in the program's system integration laboratory. Furthermore, sensor software items related to signal processing, timing, and control, as well as element measurement, are not yet mature.

Design Maturity

The critical design review was completed in December 2008. At that time, the program office released 88 percent of the estimated 6,304 engineering drawings, and expects to release the remainder of its drawings in 2009. The program has held a number of prime item critical design reviews during the year in preparation for the critical design review. However, until the maturity of the JLENS prime items have been demonstrated, the potential for design changes remains.

The JLENS program continues to define, develop, and design the mobile mooring station used to anchor the aerostat during operations. The mobile station is based on a fixed mooring station design; however, the program has yet to demonstrate its mobility. The design parameters of the vehicle that will transport the mobile asset have not yet been identified. A new "survivability" operational requirement by the Army is expected to add armor to the vehicles that will transport the mobile mooring station. According to program officials, if the survivability requirement is levied on JLENS, the combined weight of the mooring station and the up-armored vehicle will exceed the maximum allowed for roads in the United States and in a operational theater, requiring a redesign prior to incorporation of the up-armor.

Other Program Issues

The cost and schedule of the JLENS program could be affected by its synchronization with the Army's IAMD program. The IAMD program is tasked with developing a standard set of interfaces between systems such as JLENS and other sensors, weapons, and the battle management, command, control, communications, computers, and intelligence components to provide a common air picture. As part of the IAMD strategy, the Army plans to extend the system development and demonstration phase of the JLENS program by approximately twelve months and delay low rate initial production until fiscal year 2012. According to program officials, the schedule extension and associated cost growth would cause the JLENS program to breach its cost and schedule baselines

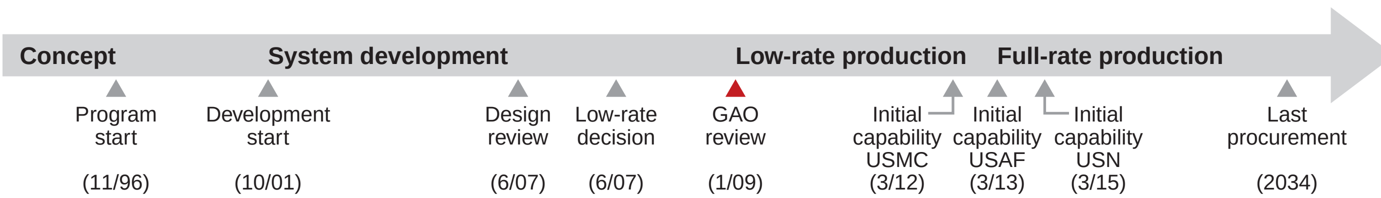
Program Office Comments

In commenting on a draft of this assessment, the JLENS program office provided technical comments which were incorporated as appropriate.

Joint Strike Fighter

The JSF program goals are to develop and field a family of stealthy strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with maximum commonality to minimize costs. The carrier-suitable variant will complement the Navy's F/A-18 E/F. The conventional takeoff and landing variant will primarily be an air-to-ground replacement for the Air Force's F-16 and the A-10 aircraft, and will complement the F-22A. The short takeoff and vertical landing variant will replace the Marine Corps' F/A-18 and AV-8B aircraft.

Source: Lockheed Martin: BF-1 (STOVL Variant).



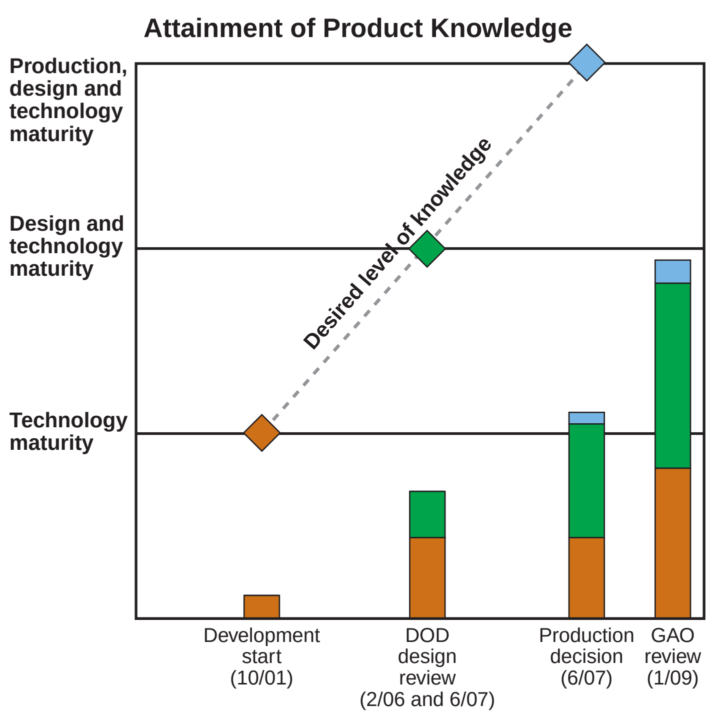
Program Essentials

Prime contractor: Lockheed Martin
Program office: Arlington, VA
Funding needed to complete:
- R&D: $10,223.2 million
- Procurement: $193,881.1 million
- Total funding: $204,465.9 million
- Procurement quantity: 2,429

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2001	Latest 09/2008	Percent change
Research and development cost	$37,645.7	$46,840.8	24.4
Procurement cost	$167,016.3	$197,437.3	18.2
Total program cost	$206,410.3	$244,772.1	18.6
Program unit cost	$72.020	$99.663	38.4
Total quantities	2,866	2,456	-14.3
Acquisition cycle time (months)	175	125	-28.6

Five of the eight JSF critical technologies are mature and three are approaching maturity. Though none of the variants demonstrated design stability at their design review, more than 90 percent of the engineering drawings for each variant have now been released. The program collects data to manage manufacturing maturity, but production inefficiencies and a lack of flight testing could result in costly future changes to design and manufacturing processes. While the program began testing its first production representative prototype in June 2008, a fully integrated, capable aircraft will not begin flight testing for 4 years. Despite these concerns, the program plans to accelerate production. Program costs have increased and the schedule has slipped since last year. A recent independent cost estimate projects even greater cost increases and schedule delays through fiscal year 2015.



JSF Program

Technology Maturity

Five of the JSF's eight critical technologies are mature. The remaining three—mission systems integration, prognostics and health management, the radar—are approaching maturity.

Design Maturity

The program reported that it had released over 90 percent of planned engineering drawings for each of the three variants indicating that the designs are generally stable. While the designs appear stable, the late release of design drawings led to manufacturing inefficiencies from which the program is still recovering.

Production Maturity

The JSF program's production processes are not mature. While the program collects information on the maturity of manufacturing processes, a good practice, only about 12 percent of its critical manufacturing processes are in statistical control. Projected labor hours have increased about 40 percent since 2007. The late release of drawings and subsequent supplier problems have led to late part deliveries, delaying the program schedule and forcing inefficient manufacturing processes. Program officials do not expect these inefficiencies to be fully corrected until 2010, during its third low rate production lot.

The JSF designs are still not fully proven and tested. Flight testing, begun in late 2006, was only about two percent completed as of November 2008. The program began testing its first production representative prototype—a short takeoff vertical landing variant flown in conventional mode—in June 2008. A fully integrated, capable aircraft is not expected to enter flight testing until 2012, increasing risks that problems found may require design and production changes and retrofits of completed aircraft.

Other Program Issues

The program continues to experience significant cost increases and schedule delays. A recent independent cost estimate identified additional funding requirements for system development of as much as $7.44 billion through fiscal year 2016. This would increase the total development costs 14 percent from $44.3 billion to $51.81 billion. The estimating team also projected a three year extension in system development. Separately, the program office has projected that development costs will increase by approximately $2.43 billion to address cost overruns on the airframe and engine contracts and to pay for a one-year schedule extension. The independent cost estimate was higher than the program office estimate because it also included (1) the alternate engine effort, (2) higher contractor engineering staff levels, (3) additional software growth, (4) an expanded flight test program, and (5) more labor hours to manufacture aircraft. Program officials argue that costs will be lower than the independent estimate because, among other things, they believe the program has made substantial progress in software development and has invested heavily in advanced simulation labs intended to reduce risk.

Despite the program's continued manufacturing problems and the infancy of the flight test program, DOD officials want to accelerate production by 169 aircraft between fiscal years 2010 and 2015. This may require up to $33.5 billion in additional procurement funding in those years. We believe this more aggressive production approach is optimistic and risky.

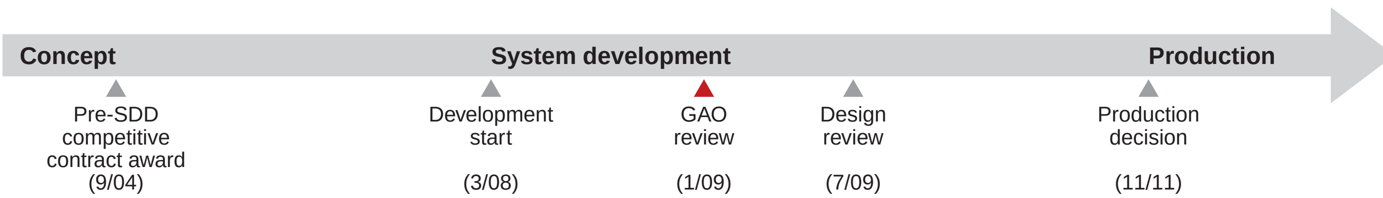
Program Office Comments

The program noted that JSF's technical, software, production processes, and testing maturity are tracking to plan and substantially exceeding standards set in past programs. The manufacturing fit and quality of the jets are unprecedented and production processes are improving with each jet. The program's second prototype test aircraft flew on the schedule established two-years prior. Software development is 65 percent complete (twelve million lines) in accordance with the spiral development plan/schedule and with record-setting code-writing efficiencies. The software demonstrates stability across multiple mission system subsystems. Systems integration testing continues on schedule through the use of flight tests, a flying lab, and over 150,000 hours of ground labs testing. A fully integrated mission systems jet is scheduled to fly in 2009. The latest DOD independent cost estimate increased little from the one of four years ago. The second production lot contract was signed for a price below the cost model prediction. The program's plan for incremental blocks of capability balances cost, schedule and risk.

Joint Tactical Radio System Airborne, Maritime, Fixed-Station (JTRS AMF)

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority that cuts across the military services. Program and product offices develop hardware and software for users with similar requirements. The AMF program will develop radios and associated equipment for integration into nearly 160 different types of aircraft, ships, and fixed stations.

Source: JTRS AMF—Airborne/Maritime Fixed Station "Notional".



Program Essentials

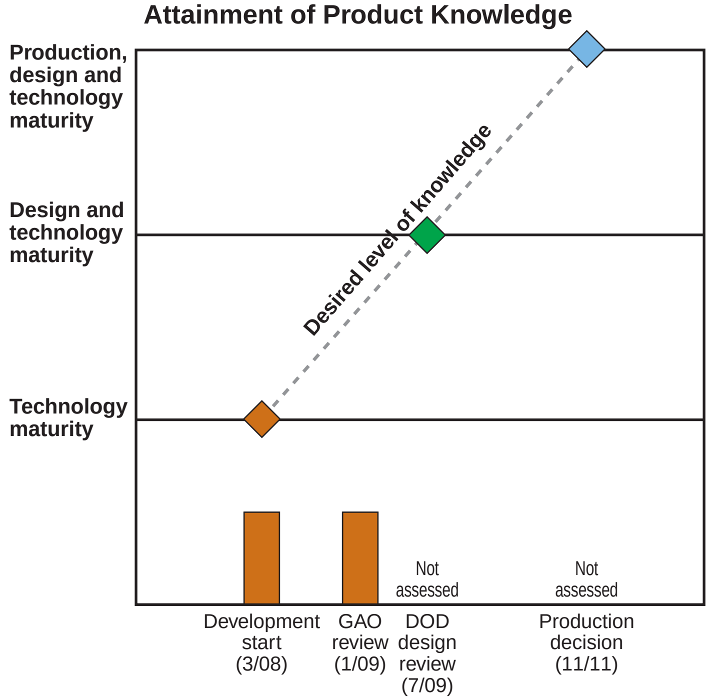
Prime contractor: Lockheed Martin Corp.
Program office: San Diego, CA
Funding needed to complete:
R&D: $1,375.3 million
Procurement: $6,026.0 million
Total funding: $7,401.3 million
Procurement quantity: 11,052

Program Performance (fiscal year 2009 dollars in millions)

	As of	Latest 01/2009	Percent change
Research and development cost	NA	$1,887.9	NA
Procurement cost	NA	$6,025.7	NA
Total program cost	NA	$7,913.6	NA
Program unit cost	NA	$.712	NA
Total quantities	NA	11,107	NA
Acquisition cycle time (months)	NA	NA	NA

JTRS AMF began system development in March 2008 with all five critical technologies approaching full maturity. An independent technology readiness assessment conducted prior to the start of system development found that all five critical technologies had been demonstrated in a relevant environment and were approaching full maturity. The Under Secretary of Defense for Science and Technology concurred with those findings, but expressed concern about the maturity of four technologies being developed by the JTRS Network Enterprise Domain program, on which JTRS AMF is dependent. The Under Secretary's office recommended that independent technical assessments of those technologies be conducted. The JTRS Network Enterprise Domain will implement the recommendation in future technical evaluations. The next major review of the program will be its critical design review, planned for July 2009.

Attainment of Product Knowledge



JTRS AMF Program

Technology Maturity

JTRS AMF obtained milestone B certification and began system development in March 2008 with all five critical technologies approaching full maturity. During 2006 and 2007, an independent technology readiness assessment was completed by the Army to support a decision on whether or not the program was ready to begin system development. The technology readiness assessment found that all critical technologies had been demonstrated in a relevant environment. An independent review team representing the Under Secretary of Defense for Science and Technology reviewed the technology readiness assessment and concurred with those findings.

However, the Under Secretary of Defense for Science and Technology also expressed concern about four technologies being developed by the JTRS Network Enterprise Domain program, on which JTRS AMF is dependent. These technologies include waveforms and network management services. To address this concern, the Under Secretary recommended that the JTRS Joint Program Executive Office conduct an independent technical assessment of the Network Enterprise Domain's waveforms, networking, and network management approaches. In addition, the Under Secretary recommended that a technology readiness assessment be conducted on the networking and Mobile User Objective System waveforms and network management software to show that they are mature before being inserted into the JTRS AMF program. According to program officials, these recommendations will be implemented by the JTRS Network Enterprise Domain program in future technical evaluations.

Prior to the start of system development, the JTRS AMF program took steps to develop key product knowledge. In 2004, the program awarded competitive system design contracts to two industry teams led by Boeing and Lockheed Martin to help mitigate technical risks and address key integration challenges. DOD has incorporated a similar approach in its acquisition policies.

Other Program Issues

The JTRS AMF radio set must meet the network and computer security requirements as specified by the National Security Agency (NSA) JTRS Unified INFOSEC Criteria (UIC) and obtain NSA certification. While this is a high-risk area that may have negative effect on program costs and schedule if not completed, program officials expressed confidence that the program's risk mitigation strategy and plan sufficiently reduce this risk to an acceptable level for obtaining NSA approval of a certifiable security architecture. Current AMF program critical design review is planned for July 2009.

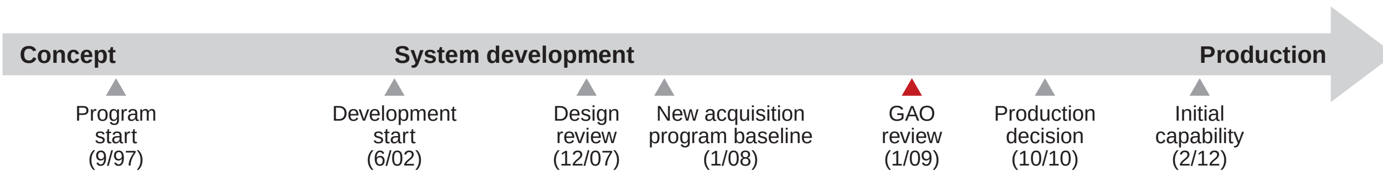
Program Office Comments

In commenting on our draft, the program office generally concurred with our findings and offered technical comments for our consideration. We incorporated the technical comments where appropriate.

Joint Tactical Radio System Ground Mobile Radio (JTRS GMR)

DOD's JTRS program is developing software-defined radios that will interoperate with select radios and also increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority and balances acquisition actions across the services, while product offices are developing radio hardware and software for users with similar requirements. The JTRS Ground Mobile Radio office, within the JTRS Ground Domain program office, is developing radios for ground vehicles.

Source: JPEO JTRS.



Program Essentials

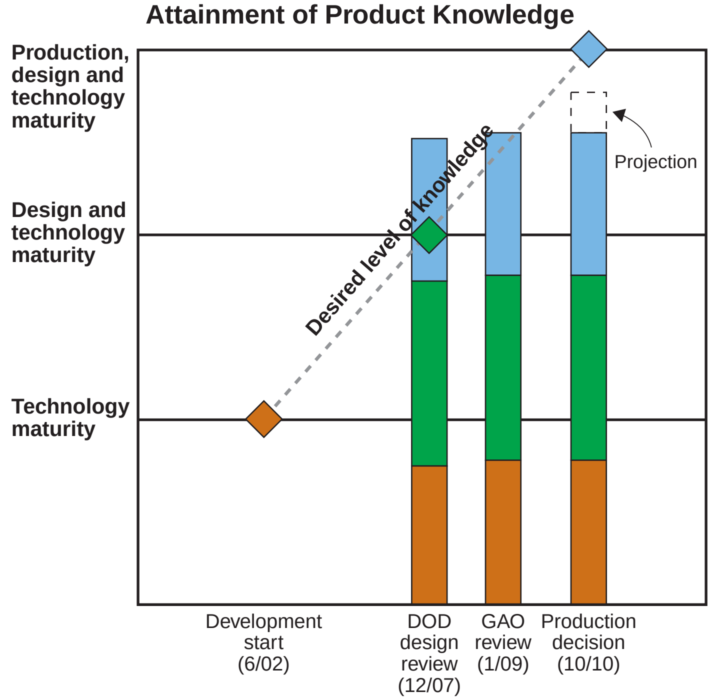
Prime contractor: The Boeing Company
Program office: San Diego, CA
Funding needed to complete:
- R&D: $335.5 million
- Procurement: $15,200.6 million
- Total funding: $15,536.1 million
- Procurement quantity: 86,512

Program Performance (fiscal year 2009 dollars in millions)

	As of 06/2002	Latest 12/2007	Percent change
Research and development cost	$985.0	$1,399.8	42.1
Procurement cost	$15,841.6	$15,200.6	-4.0
Total program cost	$16,826.6	$16,600.3	-1.3
Program unit cost	$.155	$.192	23.4
Total quantities	108,388	86,652	-20.1
Acquisition cycle time (months)	55	114	107.3

Twelve of JTRS GMR's 20 critical technologies are now mature, 7 are nearing maturity, and 1 is still immature. According to the program office, the design is stable and the first two engineering development models were delivered in September 2008. However, until the remaining critical technologies are demonstrated in a realistic environment, the potential for design changes remains. The cost and content of the program continues to change. The Under Secretary of Defense for Acquisition, Technology and Logistics, has directed the program to replace its January 2008 acquisition program baseline with a revised baseline supported by a new cost estimate. In addition, two waveforms previously cut from the program have been reinstated. Program officials report that GMR is on track to complete the Security Verification Test in fiscal year 2010 to receive the system security certification.

Attainment of Product Knowledge



JTRS GMR Program

Technology Maturity

The JTRS GMR program started system development in 2002 with none of its 20 critical technologies mature. Currently, 19 critical technologies are either mature or approaching maturity. The remaining immature critical technology—bridging/retransmission software—is currently in development and, according to the program office, will be implemented and demonstrated in upcoming Integrated Builds.

Design Maturity

The design of the JTRS GMR currently appears stable. The program held its critical design review in December 2007 and reported that all of the expected design drawings were releasable at that time. However, the potential for design changes remains. All the program's critical technologies have not been demonstrated in a realistic environment and the content of the program has changed. In September 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics, directed the program to reinstate two waveforms that were previously cut from the program.

Production Maturity

The program has reported that approximately 77 percent of its critical manufacturing processes were expected to be in statistical control when the program makes its low-rate production decision in 2010. However, program office staff recently reported that the program office was working with the contractor to obtain an updated estimate of processes that will be in statistical control at the time of the low-rate production decision. By not having all processes in statistical control, there is a greater risk that the radio will not be produced within cost, schedule, and quality targets.

The JTRS GMR program is already producing pre-engineering and engineering-development models for use in testing. The Army's Future Combat Systems program has procured 121 GMR pre-engineering development model sets, which were installed on Bradley, Abrams and High Mobility Multi-purpose Wheeled Vehicle platforms, and has ordered 153 GMR engineering development model sets. According to the JTRS GMR program office, the first two engineering development models were delivered in September 2008.

Other Program Issues

The JTRS program was restructured in 2006, and in January 2008 the GMR Acquisition Program Baseline was revised reflecting this restructure. The program office has been measuring performance against this January 2008 baseline. In August 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics completed an in-depth review of the overall JTRS enterprise and each JTRS program. As a result, the Under Secretary directed the program to update the GMR cost estimate to support another updated Acquisition Program Baseline. DOD's Cost Analysis Improvement Group was tasked with developing an independent cost estimate for the GMR program. In addition, the program is to develop a backup plan to address potential schedule slips. The Under Secretary also directed the program to address potential performance issues: specifically it is to reinstate two waveforms and to collaborate with other DOD departments to address the need for lab and field tests of at least 30 nodes for the Wideband Networking Waveform.

The cost of the JTRS GMR program continues to grow. According to the program office, the primary drivers of recent increases in program's estimated cost were (1) the implementation of design changes to respond to the National Security Agency's assessment of vulnerability; (2) higher Soldier Radio Waveform development and porting costs than estimated in the contractor's 2006 proposal; and (3) contractor performance in hardware and software development. Although research and development costs have continued to increase, the program office stated that procurement cost estimates have decreased slightly since it developed its January 2008 acquisition program baseline. According to program office officials, the decrease was based on revised estimates and data on the actual costs of engineering development models. However, current estimated program acquisition unit costs are still almost 20 percent higher than originally estimated for the 2002 Milestone B Acquisition Program Baseline.

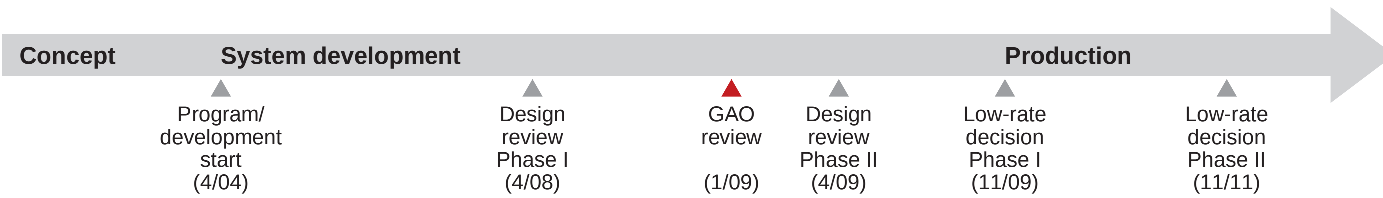
Agency Comments

In commenting on a draft of this assessment, the JTRS Joint Program Executive Office provided technical comments, which were incorporated as appropriate.

JTRS Handheld, Manpack, Small Form Fit (JTRS HMS)

The JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. The JTRS HMS product office, within the JTRS Ground Domain program office, is developing handheld, manpack, and small form fit radios. The program includes two concurrent phases of development. Phase I includes select small form fit radios, while Phase II includes small form fit radios with enhanced security as well and handheld and manpack variants. We assessed both phases.

Source: General Dynamics C4 Systems.



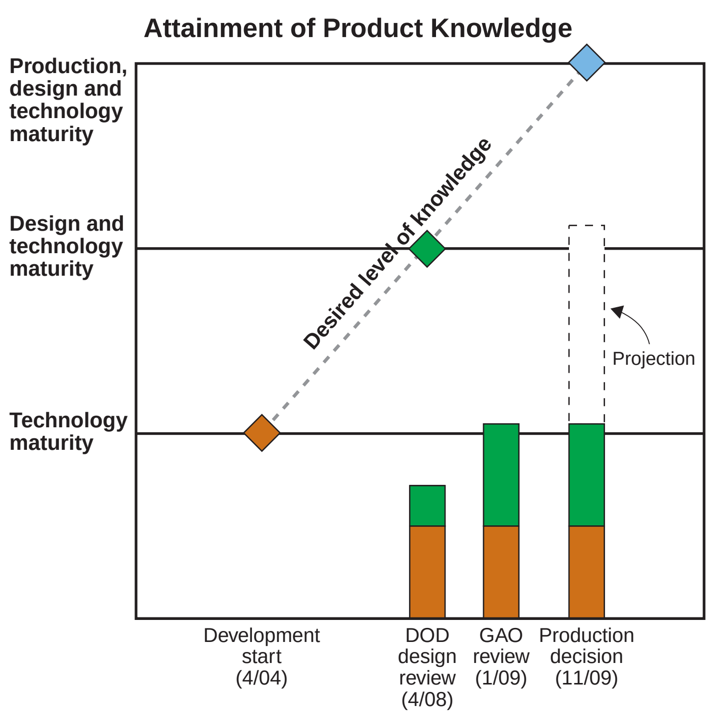
Program Essentials

Prime contractor: General Dynamics C4 Systems
Program office: San Diego, CA
Funding needed to complete:
- R&D: $71.7 million
- Procurement: $2,189.3 million
- Total funding: $2,261.0 million
- Procurement quantity: 95,551

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2004	Latest 12/2007	Percent change
Research and development cost	$526.1	$833.5	58.4
Procurement cost	$9,168.5	$2,189.3	-76.1
Total program cost	$9,694.5	$3,022.7	-68.8
Program unit cost	$.029	$.031	7.1
Total quantities	329,574	95,961	-70.9
Acquisition cycle time (months)	85	93	9.4

The critical technologies for JTRS HMS have changed as a result of the program's 2006 restructuring. Currently, Phase I includes two critical technologies, both of which are approaching maturity. Critical technologies for Phase II have yet to be defined. Developing multiple layers of communication security and obtaining National Security Agency certification continues to be a challenge, along with designing the two-channel handheld to meet size, weight, power, and thermal requirements. The key networking waveform has been tested in a field experiment, but program officials report that it will take additional efforts to transition the waveform to an operational platform. The program has completed critical design review for Phase I, and is scheduled to complete critical design review for Phase II in 2009. The program has delivered 230 prototype radios for testing and evaluation.



JTRS HMS Program

Technology Maturity

The JTRS HMS program started system development in 2004 with only one of its six critical technologies mature. In 2006, the program was restructured to include two concurrent phases of development. Phase I, which intends to maximize the use of commercial off the shelf components and products, includes two critical technologies—logical partitioning and software power management. The program has not completed an independent technology assessment, but program officials note that both technologies are approaching maturity.

Critical technologies for Phase II, which includes the handheld and manpack variants, will be defined in a technology readiness assessment scheduled to begin in 2010. The development of the Phase II two-channel handheld continues to pose a significant risk for the program. The risk stems from trying to meet size, weight, power, and thermal requirements with current technologies. DOD and program leadership are currently assessing the viability of this radio as well as alternatives as part of the Ground Domain Fielding Strategy. The program has added a nonembedded and embedded variant of its Small Form Fit-C radio, referred to as the Rifleman Radio, to Phase I. This radio will support protected communications within fire teams and squads.

Design Maturity

Phase II design, which includes the handheld and manpack variants, is not stable. The program has completed critical design review for Phase I, and is scheduled to complete critical design review for Phase II in 2009. The program has released about 90 percent of the Phase I drawings and about 37 percent of Phase II drawings to the manufacturer. It is important to note that drawings for the two-channel handheld are not included in the Phase II drawing count. The reason for this exclusion is that the two-channel handheld effort has been put on hold for fiscal year 2009.

Production Maturity

The program has identified 24 critical manufacturing processes, but the program only collects statistical process control data for 3 of them. According to program officials, the program is implementing key processes to mitigate production risks, which include participation in contractor risk review boards, emphasizing cost and earned value management, and overall rigor of the system engineering process. The program also noted that there are no unique processes associated with the HMS program. However, by not having all the key processes in control, there is a greater risk that the radio will not be produced within cost, schedule, or quality targets. The program has delivered 230 prototype radios for testing and evaluation, which includes 84 small form fit prototypes for various FCS platforms.

Other Program Issues

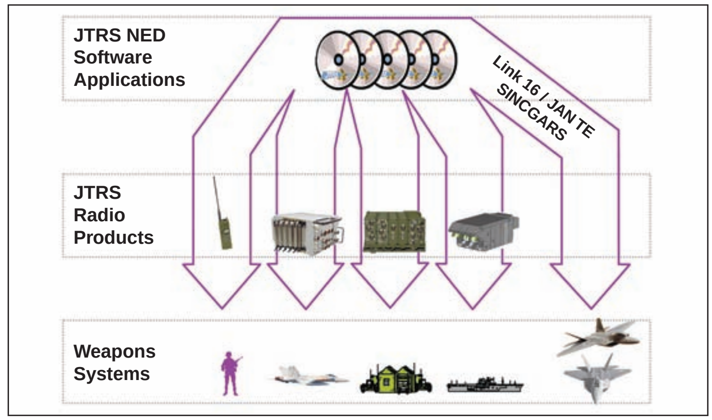
While JTRS was originally intended to replace virtually all legacy radios, this is no longer a practical or affordable investment strategy for DOD and the services. JTRS is still critical to networking the force, but the strategy of a wholesale replacement of radios is being reconsidered. The unit cost for the HMS program will vary significantly by form factor, from an estimated $1,800 for the Rifleman Radio to about $55,000 for the manpack radio. Given these high costs, DOD and the services have scaled back the number of JTRS radios they plan to buy. The total planned quantity of JTRS HMS radios was recently reduced from an original baseline of about 330,00—established in May 2004—to about 96,000, a 71 percent decrease.

Agency Comments

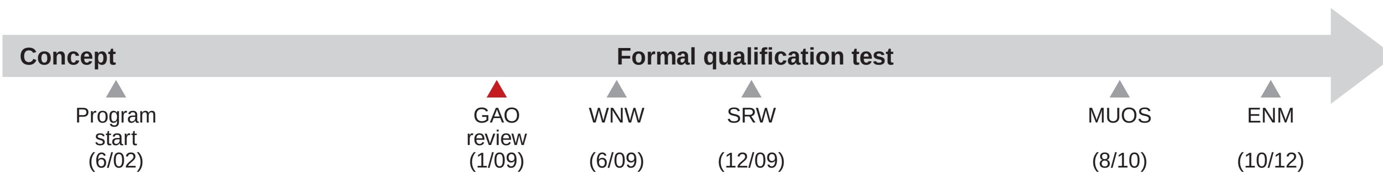
Program officials noted that they are in the process of updating their Acquisition Program Baseline and Selected Acquisition Report to show an increase in quantities of 120,000 radios. This increase is attributed to requirements identified for the Small Form Fit Factor-C radio also known as the Rifleman Radio. In addition, the program provided technical comments, which were incorporated as appropriate.

Joint Tactical Radio System Network Enterprise Domain

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority. The Network Enterprise Domain (NED) is responsible for the development of products or software applications that will operate on the JTRS radios. We assessed the Wideband Networking Waveform (WNW) and Soldier Radio Waveform (SRW), which provide key advanced networking capability.



Source: JTRS Network Enterprise Domain.



Program Essentials

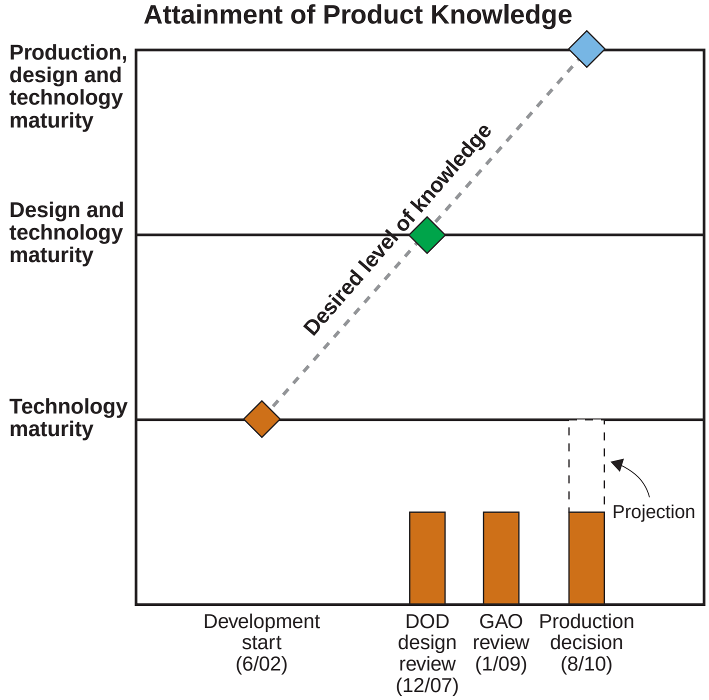
Prime contractor: Various
Program office: San Diego, CA
Funding needed to complete:
R&D: $787.8 million
Procurement: NA
Total funding: $787.8 million
Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 06/2002	Latest 08/2008	Percent change
Research and development cost	$947.4	$2,031.7	114.5
Procurement cost	NA	NA	NA
Total program cost	$947.4	$2,031.7	114.4
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

The NED program develops legacy and networking waveforms and Network Enterprise Services for the JTRS radios. The one critical technology element for both WNW and SRW—the Mobile Ad Hoc Networking—is approaching maturity and is expected to be fully mature by August 2010. The program office reported progress in developing and testing the WNW and SRW waveforms. The next critical milestone for both is formal qualification tests. These tests are scheduled for June 2009 and December 2009 for WNW and SRW, respectively. NED is a software development effort and does not have design drawings. The NED program requirement is for delivery of a complete set of software requirements, design, and test documentation as well as the code. Officials assess waveform design stability and maturity using software development metrics and reported low requirements and design volatility for both waveforms.

Attainment of Product Knowledge



JTRS NED Program

Technology Maturity

The JTRS NED program's one critical technology element for both WNW and SRW—the Mobile Ad Hoc Networking—is approaching maturity and is expected to be fully mature by August 2010. JTRS NED is a software development effort, and the major milestones are the formal qualification tests (FQT). The first FQT for SRW was successfully performed for the Unattended Ground Sensor / Non-Line of Sight-Launch System ending in September 2008, and NED will be conducting other FQTs for other domains in 2009. Similarly, WNW was successfully demonstrated during a field experiment ending in October 2008 that included a multi-subnet test by Future Combat Systems personnel. The final version of WNW is expected to complete FQT in June 2009.

The SRW effort has experienced cost growth and schedule inefficiencies because the contractor underestimated the complexity of the work and could not close their software deficiency reports. However, the program office reports that both SRW and WNW software developments have, for the most part, added the necessary functionality and are currently in the Software Integration Testing phase of the software development lifecycle.

Design Maturity

We could not assess design stability, because the JTRS NED is a software development effort and does not have design drawings. Instead, program officials indicated that waveform design stability and maturity are evaluated using metrics such as waveform requirements and design volatility, software lines of code counts, and software defect reports. The NED program office reported that since December 2007, the waveforms show less than 5 percent requirements volatility and less than 1 percent design volatility.

Other Program Issues

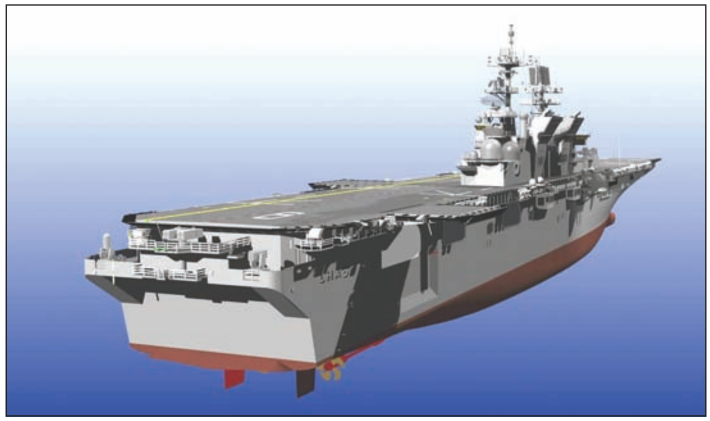
In a September 2008 acquisition decision memorandum, the Under Secretary of Defense for Acquisition, Technology and Logistics directed the JTRS Joint Program Executive Office to work with other DoD offices to assess resources and identify the funding needed for a 30-node or larger test of the WNW and Ground Mobile Radio in fiscal year 2009. That test is currently scheduled for May 2009. WNW and SRW are key enabling technologies for Future Combat Systems.

Program Office Comments

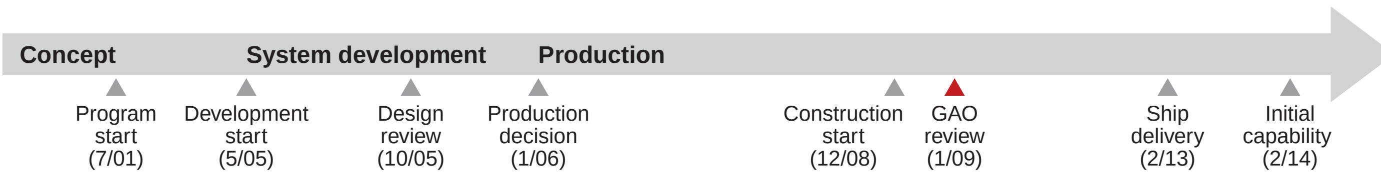
In commenting on a draft of this assessment, the JTRS Joint Program Executive Office provided technical comments which were incorporated as appropriate.

LHA 6 Amphibious Assault Ship Replacement Program

The Navy's LHA 6 will replace the aging LHA 1 Tarawa-class amphibious assault ships. The LHA 6 is a modified variant of the LHD 8 amphibious assault ship which is currently under construction. The LHA 6 features enhanced aviation capabilities and is designed to support all Marine aviation assets in the Expeditionary Strike Group, including the V-22 Osprey and the F-35B Joint Strike Fighter. Fabrication of the LHA 6 modules began in February 2008 and ship delivery is anticipated for February 2013.



Source: LHA-6 Program Office.



Program Essentials

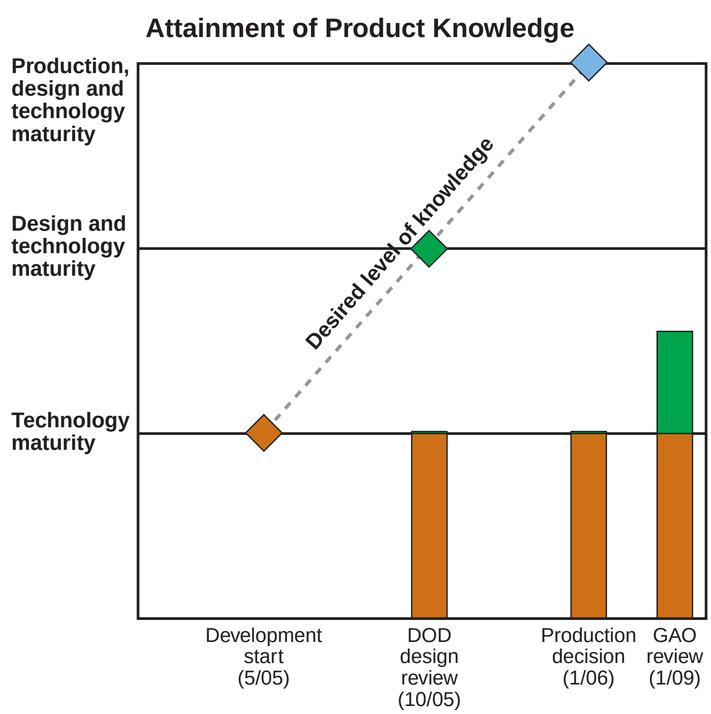
Prime contractor: Northrop Grumman Ship Systems
Program office: Washington, DC
Funding needed to complete:
- R&D: $28.4 million
- Procurement: $154.8 million
- Total funding: $183.2 million
- Procurement quantity: 0

Program Performance (fiscal year 2009 dollars in millions)

	As of 01/2006	Latest 08/2008	Percent change
Research and development cost	$213.4	$217.0	1.7
Procurement cost	$2,858.1	$3,069.6	7.4
Total program cost	$3,071.5	$3,286.6	7.0
Program unit cost	$3,071.497	$3,286.591	7.0
Total quantities	1	1	0.0
Acquisition cycle time (months)	146	151	3.4

Cost data do not yet reflect the change in ship delivery date.

DOD and the Navy assert that there are no critical technologies associated with the LHA 6 program because all critical systems and equipment utilize technologies that have been developed for existing Navy programs. The program did identify six key subsystems needed to achieve full LHA 6 capabilities. Development of the machinery control system, which the program office considers its biggest remaining technology risk, will begin in 2009. Approximately 50 percent of the ship's detail design drawings are currently releasable. Fabrication began on modules of the ship in February 2008, though the official start of construction was delayed to December. Ship delivery is expected to be delayed from August 2012 to February 2013 due to productivity and workforce management issues at the shipyard. Officials indicated that any cost growth associated with this delay has not yet been determined.



LHA 6 Program

Technology Maturity

In 2005, DOD and the Navy concluded that all LHA 6 components and technologies were fully mature. Although not considered critical technologies, the program did identify six key subsystems needed to achieve full LHA 6 capabilities. Five of these are mature and installed on numerous Navy ships and do not require modification for installation on the LHA 6. The sixth, the Joint Precision Approach and Landing System (JPALS), a Global Positioning System (GPS)-based aircraft landing system, is not mature. However, JPALS, which will be used to support all-weather landings of next-generation fleet aircraft, is not needed to achieve LHA 6's operational requirements and the ship's construction is not dependent on JPALS availability.

Previously, the program office has identified the machinery control system as a subsystem that may pose some risk. Development of this system is scheduled to begin by March 2009. The LHA 6 machinery control system will be based largely on the LHD 8 system, using 99 percent of its software code. While the LHA 6 system will be less complex and have fewer signals than the LHD 8 system, the development of the machinery control system on the LHD 8 was delayed and program officials have identified it as that ship's biggest technology risk.

Design Stability

About 50 percent of the ship's detailed design drawings are complete. Approximately 45 percent of the LHA 6 design is expected to be based on the LHD 8. Changes from the LHD 8 to the LHA 6 include the expansion of the aviation hangar and removal of the well deck to accommodate more aircraft and create additional aviation fuel capacity. In October 2005, the Navy conducted a design review of the LHA 6 and determined its preliminary design was stable. However, program officials indicated that despite the similarities between the LHD 8 and the LHA 6, modifications of the LHD 8 design for LHA 6 have caused the shipbuilder to redraw rather than reuse more drawings than expected. This has increased engineering hours and led to a subsequent delay in completing design activities.

Production Maturity

We did not assess production maturity because the shipbuilder does not use statistical process controls. Ship delivery for the LHA 6 is expected to be delayed from August 2012 to February 2013. The program's planned April 2008 review to determine the shipyard's readiness to begin ship construction was postponed until September due to workload management and productivity concerns at the yard. Despite these concerns, the shipbuilder began construction on 25 of the ship's 191 units by August 2008—though not at the planned rate. According to program officials, unit level readiness reviews have been completed for all modules on which construction has begun and construction is not proceeding out of sequence. The shipbuilder plans to ramp up construction in December 2008; however, it is facing a short supply of workers with critical craftsmanship skills and continues to struggle with worker attendance and attrition.

Other Program Issues

The LHA 6 has experienced $14.3 million in cost growth in the last year due to a transfer of work between shipyards. In the fall of 2007, the Navy authorized the shipbuilder to move some construction to Newport News, Virginia, from the Gulf Coast yard, where a majority of the ship will be constructed. As work transitioned between the yards, labor and process inefficiencies resulted in cost growth.

Program Office Comments

The Navy did not agree with GAO's assessment of design and production knowledge. The Navy stated that the LHA 6 has a stable design that meets requirements with sufficient detail design complete for its production phase. In addition, the Navy noted the shipyard has previously demonstrated mature production processes that are stable and repeatable on LHA 6 and does not need to develop any new or modified production techniques to construct LHA 6.

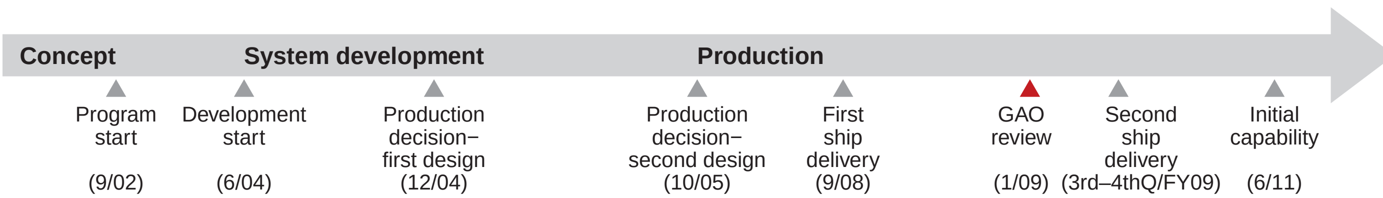
GAO Response

For the purpose of this assessment, design stability is reached when 90 percent of the system's detailed design drawings are released. At the time of this assessment, the LHA 6 had not yet reached this critical level, and, in addition, the program did not complete design activities as scheduled due to the addition of unplanned work. Further, as indicated above, the shipbuilder continues to struggle with productivity and capacity to construct the ship on schedule.

Littoral Combat Ship (LCS)

The Navy's LCS is designed to perform mine countermeasures, anti-submarine warfare, and surface warfare missions. It consists of the ship itself—the seaframe—and the mission package it deploys. The Navy plans to construct the first seven LCS seaframes in two unique designs. The first seaframe (LCS 1) was delivered in September 2008, and the Navy expects the second seaframe (LCS 2) to be delivered by September 2009. We assessed the first two seaframes (known as Flight 0). See pages 107-108 for an assessment of LCS mission packages.

Source: Alion Science.



Program Essentials

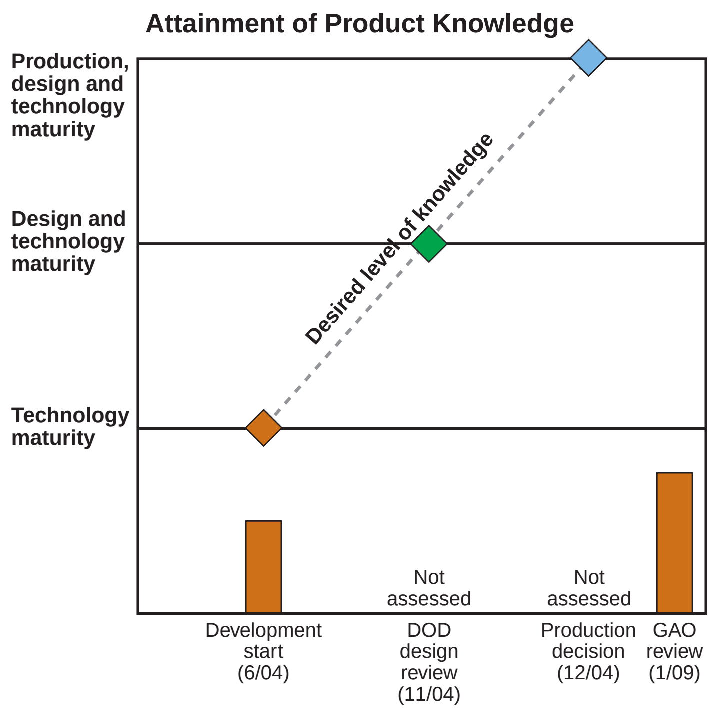
Prime contractor: General Dynamics, Lockheed Martin
Program office: Washington, DC
Funding needed to complete:
- R&D: $354.6 million
- Procurement: $946.7 million
- Total funding: $1,301.2 million
- Procurement quantity: 2

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2004	Latest 07/2008	Percent change
Research and development cost	$856.7	$2,147.9	150.7
Procurement cost	$455.5	$1,774.0	289.5
Total program cost	$1,312.1	$3,921.9	198.9
Program unit cost	$328.035	$560.275	70.8
Total quantities	4	7	75.0
Acquisition cycle time (months)	41	85	107.3

Baseline estimates above are for seaframe-related costs only. Research and development funding includes detail design and construction of two ships.

Fifteen of 19 critical technologies for the two seaframe designs are fully mature, and 2 technologies are approaching maturity. The overhead launch and retrieval system in the LCS 1 design and the aluminum structure in the LCS 2 design are immature. The Navy also identified watercraft launch and recovery as a major risk affecting both designs. Final integration of mission package vehicles will not begin until 2010 with the LCS 1 seaframe. Acceptance trials for LCS 1 uncovered several deficiencies. Most notably, the Navy found that LCS 1 may not meet stability requirements in the event of critical damage. In response, the Navy is taking steps to reduce the weight and increase the buoyancy of the design. The Navy plans to award contracts for the next two seaframes absent validated earned value management systems—needed to ensure reliable cost and schedule data—in both LCS shipyards.



LCS Program

Technology Maturity

Fifteen of 19 critical technologies for the two seaframe designs are fully mature, and 2 technologies are approaching maturity. The overhead launch and retrieval system in the LCS 1 design and the aluminum structure in the LCS 2 design are immature. The Navy identified the watercraft launch and recovery concept as a major risk to both seaframe designs. This capability is essential to complete the LCS anti-submarine warfare and mine countermeasures missions. According to the Navy, industry watercraft launch and recovery designs are unproven. To mitigate risk, the Navy is conducting launch and recovery modeling and simulation, model basin testing, and experimentation and is encouraging the seaframe industry teams to adopt similar approaches. Final integration of mission package vehicles with each seaframe will not occur until post-delivery test and trials—planned first for LCS 1 in 2010 using the mine countermeasures mission package. Any problems detected could require redesign and costly rework, which could delay the introduction of LCS to the fleet.

Design and Production Maturity

The Navy assesses LCS design stability by monitoring changes to requirements documents, execution of engineering change proposals, and the completion of contract deliverables related to drawings, ship specifications, and independent certification of the design. Construction is monitored using earned value management and through evaluation of manufacturing hours spent on rework, deficiencies detected and corrected, and the number of test procedures performed.

The Navy adopted a concurrent design-build strategy for the first two LCS seaframes, which has proven unsuccessful. Contributing challenges included the implementation of new design guidelines, delays in major equipment deliveries, and an unwavering focus on achieving schedule and performance goals. These events drove low levels of outfitting, out-of-sequence work, and rework—all of which increased construction costs. Also, incomplete designs during construction led to weight increases for both seaframes. According to the Navy, this weight growth contributed to a higher than desired center of gravity on LCS 1 that degraded the stability of the seaframe. In fact, an inclining experiment performed during acceptance trials showed LCS 1 may not meet Navy stability requirements for the damaged ship condition. The Navy is taking steps to remove weight and implement stability improvements for LCS 1, while also incorporating design changes for future seaframes.

Other Program Issues

As part of LCS 1 acceptance trials, the Navy's Board of Inspection and Survey (INSURV) identified 21 critical "starred" deficiencies and recommended the Chief of Naval Operations authorize delivery of LCS 1 after correction or waiver of these deficiencies. According to Navy officials, only 9 of these deficiencies were corrected prior to delivery. Navy officials report that transiting the ship away from Marinette, Wisconsin, prior to the winter freeze was a higher priority than timely correction of starred deficiencies. The Navy intends to correct remaining deficiencies during planned post-delivery maintenance availabilities. The Navy plans to hold an INSURV review of LCS 2 upon completion of construction and builder's trials for that seaframe.

Navy officials report that the earned value management systems in each of the LCS shipyards do not meet Defense Contract Management Agency requirements for validation. Thus, the cost and schedule data reported by the prime contractors cannot be considered fully reliable by the Navy when evaluating contractor cost proposals or negotiating for construction of follow-on ships.

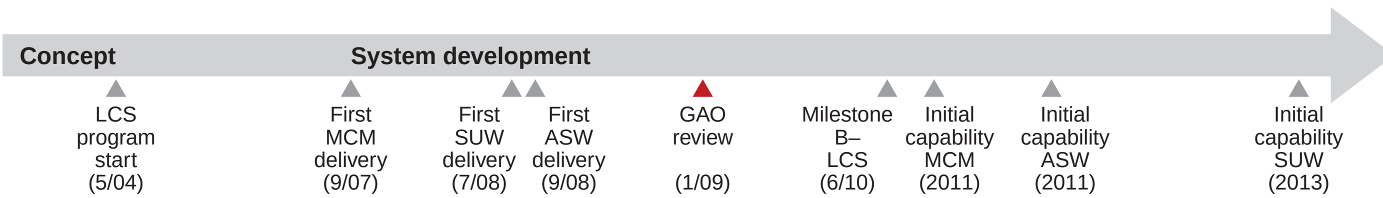
Program Office Comments

The Navy stated the LCS program is delivering vital capabilities to the fleet and will be a critical component of the Navy. It noted that LCS 1 was delivered September 18, 2008—6 years and 1 day after the LCS program was established. In fiscal year 2009, the program will deliver a second ship of a completely different design. According to the Navy, while the initial cost and schedule objectives were overaggressive—and necessitated a concurrent design and construction plan—they provided the tension and urgency for these achievements, and lessons learned will be applied to future shipbuilding programs. In August 2008, INSURV evaluated LCS 1 and found it to be "capable, well-built, and inspection-ready." The Navy stated it is leveraging lessons learned from LCS 1 and LCS 2 to ensure future ship awards provide the right mix of capability and affordability.

Littoral Combat Ship - Mission Modules

The Navy's Littoral Combat Ship (LCS) will perform mine countermeasures, surface warfare and antisubmarine warfare missions using modular mission packages. Packages include weapons and sensors that operate from MH-60 helicopters or unmanned underwater, aerial, or surface vehicles. Initial packages are partially capable. They include engineering development models and some, but not all, systems planned. Mission capability improves with each package delivered until it reaches a baseline capability of production representative systems.

Source: © Northrop Grumman Corporation.



Program Essentials

Prime contractor: Northrop Grumman
Program office: Washington, DC
Funding needed to complete:
- R&D: $274.2 million
- Procurement: $2,869.4 million
- Total funding: $3,143.7 million
- Procurement quantity: 58

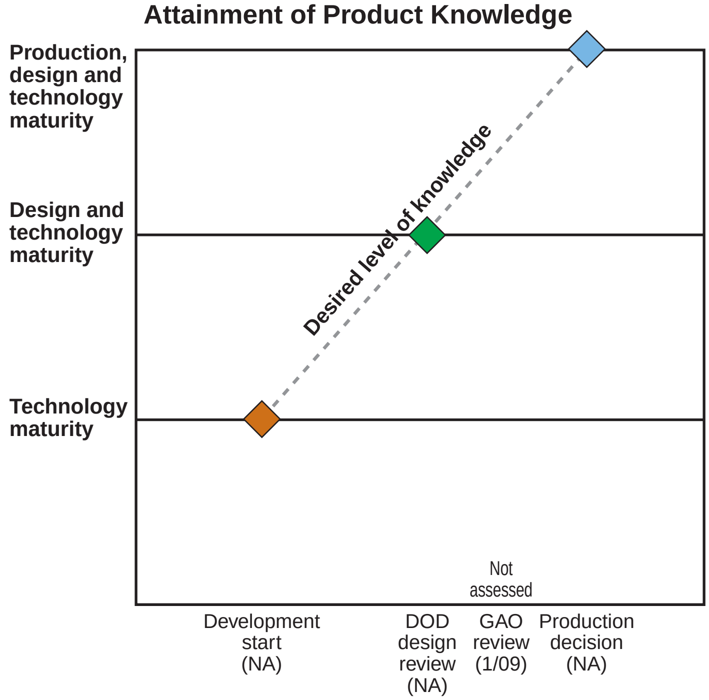
Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2007	Latest 11/2008	Percent change
Research and development cost	$475.0	$780.3	64.3
Procurement cost	$3,147.8	$2,986.7	-5.1
Total program cost	$3,622.8	$3,767.0	4.0
Program unit cost	$56.607	$58.860	4.0
Total quantities	64	64	0.0
Acquisition cycle time (months)	NA	NA	NA

Above comparison of costs reported in 2007 and 2008 does not include mission package common equipment, or the helicopter or vertical takeoff and landing unmanned aerial vehicle.

Operation of the Mine Countermeasures (MCM), Surface Warfare (SUW), and Antisubmarine Warfare (ASW) packages requires a total of 25 critical technologies, including 13 sensors, 5 weapons, and 7 vehicles. Technology development has proceeded more slowly than expected. Individual mission systems in each package have experienced problems requiring design changes and resulting in schedule delay. For example, integration of MCM systems with the MH-60S helicopter has proved challenging due to problems with the cable that tows the various systems. Overall, the Navy will reach baseline capability for each package between 1 and 2 years later than previously planned. The Navy plans to procure 64 mission packages for use on 55 LCS seaframes. Procurement has slowed to keep pace with seaframe acquisition.

Attainment of Product Knowledge



LCS Modules Program

Technology Maturity

Operation of the MCM, SUW, and ASW packages on the LCS requires a total of 25 critical technologies, including 13 sensors, 5 weapons, and 7 vehicles. Of these technologies, 17 are currently mature and 8 are nearing maturity.

The first of 24 MCM packages was delivered in September 2007 and included 7 of 10 planned mission systems. Four systems are not yet mature; two of these are struggling to reach full maturity. Officials note the Organic Airborne and Surface Influence Sweep is being redesigned to address corrosion issues and the Rapid Airborne Mine Clearance System requires design changes to perform in all environmental conditions. An airborne mine countermeasures system was decertified and its tow cable is being redesigned following the results of testing with the helicopter. The Navy also decertified the Remote Minehunting System during testing in 2007 due to reliability issues, and, according to officials, results of a recent operational assessment are pending. The Navy now plans to deliver the third and fourth mission packages in fiscal year 2011 and has delayed delivery of the baseline package until fiscal year 2012.

The first of 24 SUW packages was delivered in July 2008 and included 1 of 2 planned mission systems. The SUW package includes the fully mature 30mm gun and a variant of the Army's Non-Line-of-Sight (NLOS) system (missile and launcher), which is nearing maturity. The first package consisted of two gun engineering development models, without the NLOS launcher or missiles. The NLOS design for LCS has not yet been validated. Integration of the gun with LCS is not complete. A design review for the gun module is scheduled for October 2009. Delivery of a baseline package has been delayed to fiscal year 2013.

The first of 16 ASW packages was delivered in September 2008 and included 4 of 10 planned mission systems. Three systems remain immature including the Unmanned Surface Vehicle's Dipping Sonar, the Remotely Towed Array and the Remotely Towed Array Source. Failure to develop these technologies as expected could increase reliance on the MH-60R helicopter. The Navy has delayed delivery of a second ASW package until fiscal year 2011, and delayed baseline capability from fiscal year 2011 to 2013.

Other Program Issues

The development cost of the LCS packages has increased by more than $300 million, or 64 percent since last year. Procurement costs have decreased for MCM, in part because the delivery of the more expensive baseline capability has been delayed. Reductions in fiscal year 2008 and 2009 budget requests have slowed mission package procurement to account for continuing delays in seaframe acquisition. The explanatory statement accompanying DOD Appropriation Act for Fiscal Year 2009 Congress asked the Navy to develop a plan for fielding the MCM capability independent of LCS. The program office indicates all packages are currently scheduled to undergo operational assessments with both LCS seaframe designs, beginning in June 2010. According to program officials, in September 2008, the Navy conducted a shore based integration exercise using simulated seaframe mission bays. Officials note this activity accelerated MCM mission package integration with both seaframes and reinforced previous crew training.

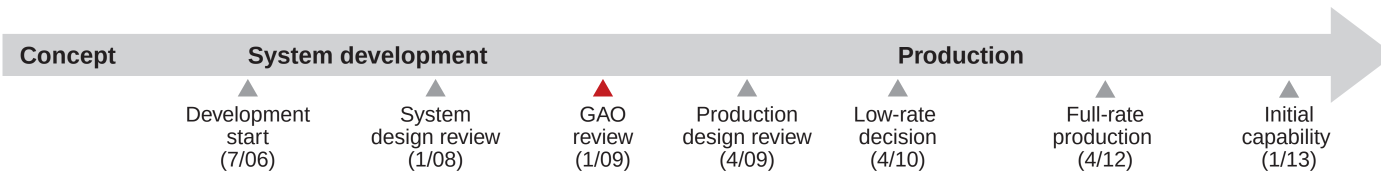
Program Office Comments

Program officials noted that changes to the program between the 2008 and 2009 president's budgets resulted in an apparent increased development cost. Costs for the SUW package bought in fiscal year 2009 were realigned from procurement to development to support technical and operational evaluations. In addition, data provided to GAO for last year's assessment did not include costs of common equipment that was subsequently distributed among the MCM and ASW packages. The program office acknowledges technical maturity challenges for some mission systems and is working closely with mission system program offices to resolve any issues. The program office is leading a coordinated test approach to prove mission package capabilities and suitability for fleet delivery. The program office also provided technical comments that were incorporated as appropriate.

Longbow Apache Block III

The Army is inserting Block III enhancements into the AH-64D Longbow Apache helicopter to ensure compatibility with the Future Combat Systems and to provide the capability to simultaneously conduct missions across the warfare spectrum. Apache Block III (AB3) upgrades are expected to amplify performance, improve situational awareness, enhance lethality, increase survivability, provide interoperability, and prevent fratricide. Upgraded AH-64D Longbow Apache helicopters are scheduled to enter service starting in 2011.

Source: Army ATTC Office, Fort Rucker; Apache PMO.



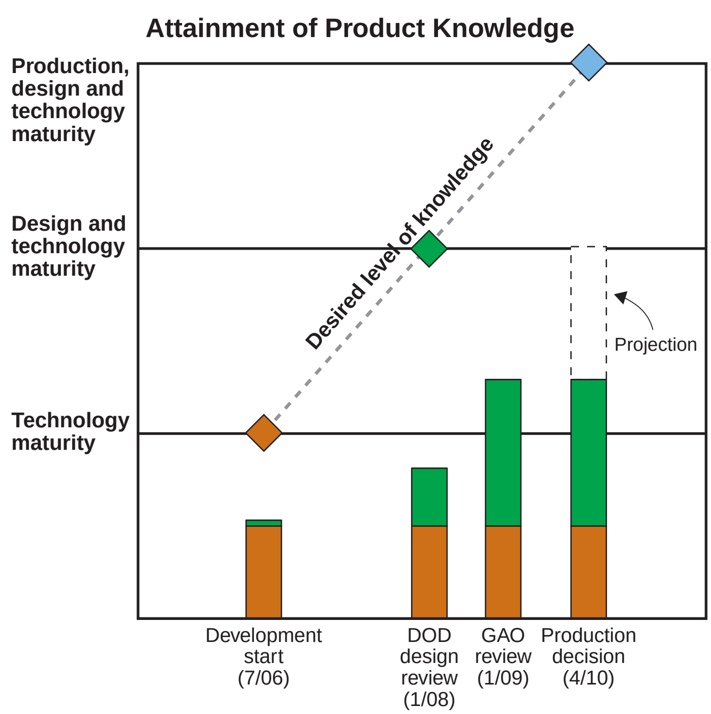
Program Essentials

Prime contractor: Boeing
Program office: Huntsville, AL
Funding needed to complete:
- R&D: $619.0 million
- Procurement: $6,616.7 million
- Total funding: $7,235.8 million
- Procurement quantity: 634

Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2006	Latest 10/2008	Percent change
Research and development cost	$1,116.0	$1,103.2	-1.2
Procurement cost	$5,878.9	$6,616.7	12.5
Total program cost	$6,995.0	$7,719.9	10.4
Program unit cost	$11.620	$12.081	4.0
Total quantities	602	639	6.1
Acquisition cycle time (months)	79	78	-1.3

The AB3 program entered system development in July 2006 with one critical technology—an improved drive system—which is approaching full maturity. The AB3 program will hold a series of design reviews corresponding with the technical insertion phases of the program. According to the program office, over 85 percent of the design drawings were released when the program completed the first of these reviews in January 2008. A subsequent production design review is scheduled for April 2009. The AB3 program successfully completed the first flight of the developmental aircraft in July 2008 as scheduled. This flight initiated the development flight test program which will culminate with a limited operational test in 2009. A decision was made this year to incorporate a new fuselage at the start of full-rate production increasing program costs by 10 percent and increasing unit costs by 4 percent.



AB3 Program

Technology Maturity

The AB3 program entered system development in July 2006 with one critical technology, an improved drive system, which is approaching full maturity. This is the first time this technology will be used in a helicopter transmission and it is expected to improve the available power and reliability over the existing transmission. The Army has plans for flight testing the improved drive system in fiscal year 2009.

The AB3 upgrade and modernization effort involves a time-phased series of technical insertions. There are three phases. First, each Apache aircraft will go to the factory for Block III modifications,which completes most of the required hardware changes. The remaining two phases of modifications consist of software improvements that can be installed in the field, which eliminates the need to return the aircraft to the factory, reduces the time an aircraft is away from the unit, and increases training time for the soldier in the field.

Design Maturity

The AB3 program has demonstrated design stability for the technology insertion phase covered during its initial design review. The AB3 program has planned for critical design reviews before the start of each technical insertion phase, and the success of each review determines the ability to move forward. There are four critical design reviews for the AB3 upgrades and modernization. According to the program office, criteria within the AB3 contract require completion of 85-90 percent of the estimated design drawings for each phase before AB3 can advance to the design review. The first critical design review held in January 2008, which served as the system level review, met this criterion. The second critical design review is scheduled for April 2009. Program officials estimate that 85-90 percent of the total design drawings will be released during this review, which will serve as the basis for the production decision scheduled for April 2010. The last two design reviews, which involve software insertions, should not significantly affect the total number of design drawings and are slated for fiscal years 2012 and 2014.

Other Program Issues

DOD decided to incorporate a new fuselage at the start of full rate production due to a dramatic increase in the number of flight hours on the existing Apache fleet. The costs associated with this new fuselage led the program to move 6 of the planned 59 low-rate initial production aircraft to later production lots. The fuselage change resulted in a 4 percent increase in unit cost and a 10 percent increase in total program cost. Program officials believe that the cost increases will be offset by operation and sustainment savings and reductions in remanufacture times.

The weight of the AB3 aircraft is considered a moderate cost risk. The current design is within its acceptable weight growth margin and program efforts have resulted in a decrease of approximately 20 pounds in the overall aircraft empty specification weight. AB3 program officials continuously monitor weight and attempt to minimize weight increases to the aircraft through contracted weight incentives, technical performance measures, and weight savings initiative programs.

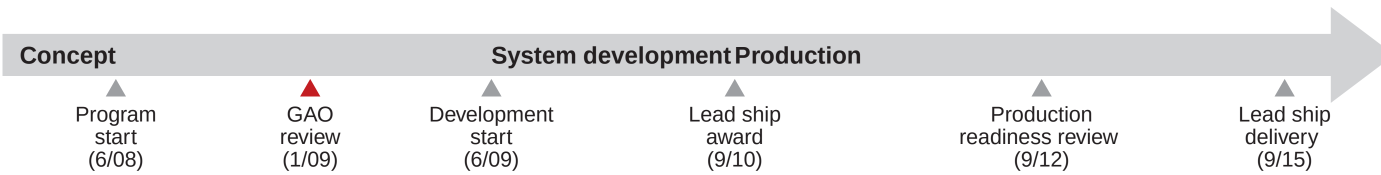
Program Office Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated where appropriate.

Maritime Prepositioning Force (Future)/ Mobile Landing Platform

The Navy's Mobile Landing Platform (MLP) is one of six classes of ships for the planned Maritime Prepositioning Force (Future)—MFP(F)—squadron that supports seabasing. The MLP would facilitate at-sea vehicle and cargo transfer, support the employment of combat ready forces from over the horizon, and serve as a staging area for supplies that support activities on shore. The Navy plans to procure a total of three MLP ships. The MLP—a new ship design for the Navy—is currently in the technology development phase.

Source: MPF(F) Program Office, notional concept.



Program Essentials

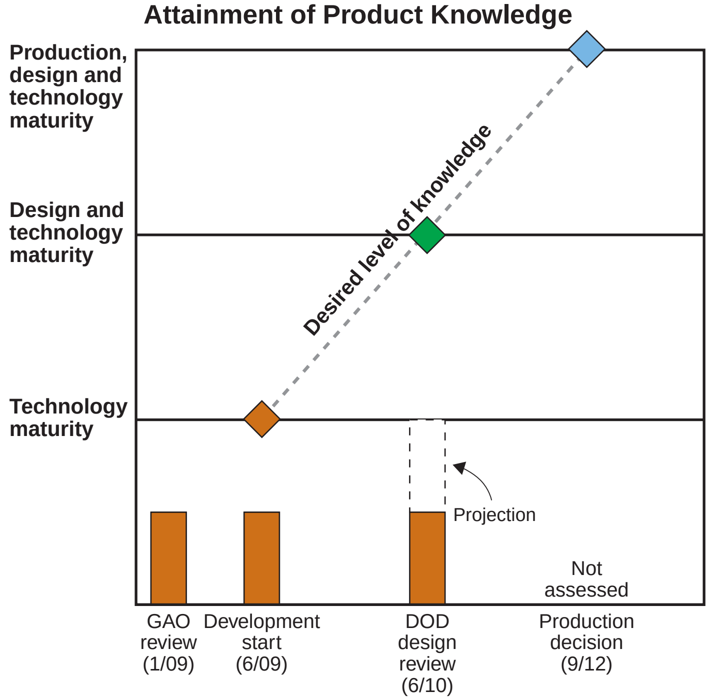
Prime contractor: TBD
Program office: Washington, DC
Funding needed to complete:
R&D: $35.3 million
Procurement: $3,042.2 million
Total funding: $3,077.5 million
Procurement quantity: 3

Program Performance (fiscal year 2009 dollars in millions)

	As of	Latest 08/2008	Percent change
Research and development cost	NA	$83.3	NA
Procurement cost	NA	$3,042.2	NA
Total program cost	NA	$3,125.5	NA
Program unit cost	NA	$1,041.830	NA
Total quantities	NA	3	NA
Acquisition cycle time (months)	NA	NA	NA

The MLP program plans to have its five critical technologies mature by design review. Of these technologies the skin-to-skin mooring and craft interface are currently mature, the crane is nearing maturity, and the remaining two technologies are immature. The program has developed a risk reduction strategy—including component and subscale model testing as well as full-scale at-sea demonstrations—to demonstrate the maturity of the vehicle transfer system and dynamic positioning system in at least a relevant environment by fiscal year 2010 when a milestone review will be held to authorize the beginning of detailed design and production. In addition, the program office plans to have its shipbuilding contractors develop system designs and virtual prototypes for ship construction as well as hull models for testing and analysis. This will assist in reducing risk for design and production.

Attainment of Product Knowledge



MPF(F)/ MLP Program

Technology Maturity

The MLP program has identified five technologies as critical to the functionality of the ship and plans to demonstrate their maturity in at least a relevant environment before the milestone review to authorize detailed design and production in 2010. The program office, as well as the Office of Naval Research and DOD, have stated that the technologies necessary for MLP do not represent high-risk development items as they can be supported by the existing industrial base and have been used in commercial and military operations. However, as the Navy has not previously integrated the technologies into a single ship design, or operated them in the expected environment, development and testing of certain technologies is still required.

Of the five technologies identified, the most mature are the skin-to-skin mooring and craft interface technologies, which allow connections between other surface ships for loading and unloading cargo. These technologies have been tested at sea through the use of surrogate platforms. According to the program office, the pendulation control system crane, which allows the transfer of 20-foot shipping containers in varying weather conditions, is nearing maturity having been demonstrated in a relevant environment in 2008. The Office of Naval Research, in cooperation with the program office, is also developing a second crane capable of transferring cargo in rougher weather conditions, but the technology remains immature and is scheduled to complete subscale testing in 2009. The vehicle transfer system and dynamic positioning system, the final two technologies for the MLP, are currently immature. The vehicle transfer system is a large ramp that allows equipment and personnel to be transferred from heavy lift ships to the MLP at sea before being loaded into landing craft for transfer to shore. The primary challenge for this technology is transferring cargo in different weather conditions while both ships are in motion. The program conducted subscale testing and land-based full-scale tests on the vehicle transfer system through 2008, and will conduct a full-scale at-sea test in 2010. The program office will utilize modeling and simulation as well as subscale tests to mature the dynamic positioning system, which aligns the MLP with other ships using position sensors and the propulsion system.

The program office plans to have shipbuilding contractors develop system designs and virtual prototypes for ship construction as well as hull models for testing and analysis. This will assist in reducing risk for design and production as well as meeting the intent of the DOD's prototyping policy as established in September 2007.

Other Program Issues

According to the program manager, the Navy has changed the acquisition approach for MPF(F) from a single acquisition squadron approach to an incremental family of ships approach with separate acquisition programs and milestone reviews. The first increment of the MPF(F) program includes the acquisition of three MLP ships and three T-AKE class cargo ships.

Program Office Comments

The program office does not agree with GAO presentation of program data in the knowledge graph. The MLP program will reach technology maturity by the design review currently planned for June 2010 when all critical technologies are expected to be demonstrated in a relevant environment or better. DOD mandates this level of maturity as exit criteria for Milestone B. The MLP program will also achieve design maturity by the design review currently planned in June 2010, when the system design will be almost 100 percent complete and stable. Production maturity will be achieved at the production readiness review, currently planned for September 2012. At the production readiness review, the program will be able to demonstrate, based on the success criteria established at Milestone B, that all production resources are in place for the MLP shipbuilder to successfully commence ship construction.

GAO Response

The knowledge graph is consistent with how we assess all programs, that is, the extent that technology has been demonstrated in a realistic environment. As the program office has not provided design or production information, and a design review or production decision has not yet occurred, progress towards achieving maturity on those areas is not reflected in the graphic.

Mine Resistant Ambush Protected (MRAP) Vehicle

The MRAP is a joint program led by the Navy and Marine Corps to procure armored vehicles to protect personnel from mine blasts and fragmentary and direct-fire weapons. DOD is acquiring three categories of vehicles: Category I for urban combat and ambulance missions; Category II for convoy escort, troop transport, explosive ordinance disposal, and ambulance missions; and Category III for clearing mines and improvised explosive devices. The Marine Corps, Army, Air Force, Navy, and Special Operations Command are acquiring vehicles.

Source: Joint MRAP Vehicle Program Office.

Concept | System development | Production

Production decision (1/07)
Contract awards (2/07)
GAO review (1/09)

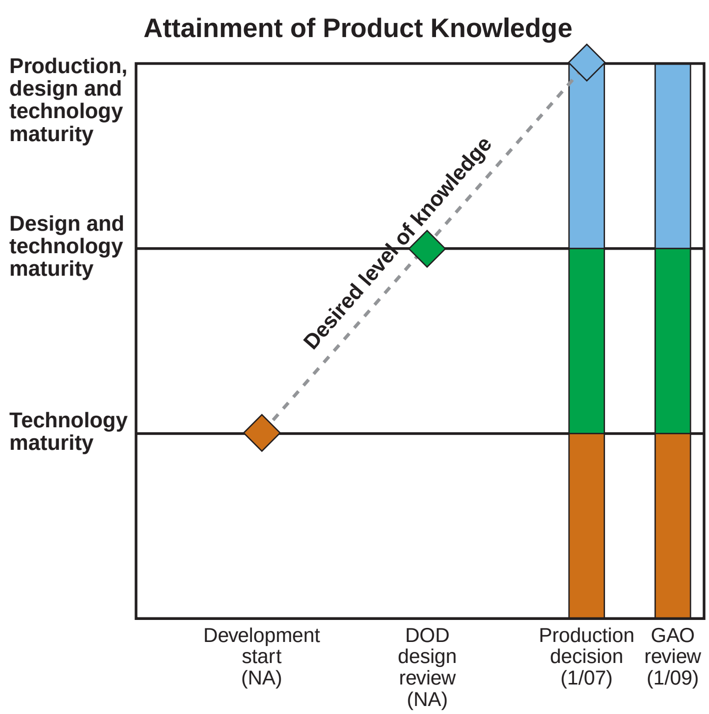
Program Essentials

Prime contractor: Various
Program office: Quantico, VA
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2007	Latest 08/2008	Percent change
Research and development cost	$232.5	$408.6	75.8
Procurement cost	$21,252.9	$26,265.5	23.6
Total program cost	$22,453.2	$27,642.1	23.1
Program unit cost	$1.460	$1.745	19.5
Total quantities	15,374	15,838	3.0
Acquisition cycle time (months)	6	6	0.0

The MRAP vehicle program is DOD's highest-priority acquisition program. To meet an urgent, joint-service operational need, DOD is buying MRAP vehicles as non-developmental items from multiple sources. For the most part, all vendors are achieving planned production rates. DOD is still grappling with a number of unknowns that could significantly increase the total ownership cost. The program is concurrently producing the baseline MRAP, developing and producing various upgrades, and potentially seeking to produce a lighter, more agile version of the vehicle. Since the MRAP is well into production and the program office has not identified any outstanding technology, design, or production issues, we have characterized each of these areas as mature.



MRAP Vehicle Program

Production Maturity

DOD is buying MRAP vehicles as non-developmental items and the production processes appear mature. While we did not assess their maturity using statistical process control data, we did assess the ability of vendors to manufacture the required number of vehicles in the time frames needed to achieve accelerated production and fielding requirements. For the most part, all vendors have achieved planned production rates and earlier concerns about obtaining sufficient quantities of ballistic steel and tires appear to have been resolved. Planned monthly production quantities will taper down as vendors near the end of their contracted deliveries. The key challenge will be ensuring availability of repair parts for vehicles in theater. DOD appears to be balancing the demand for parts required for production and demands from the field. The replacement rate for certain vehicle components, such as tires, is still unknown at this time.

Other Program Issues

In order to rapidly field the vehicles, DOD substantially compressed both developmental and operational test and evaluation. The test strategy helped to quickly identify the vehicles that protected crews, but resulted in the fielding of vehicles with significant operational issues. Automotive mobility and handling shortcomings identified during testing have also been observed in the field. DOD continues to address shortcomings through a combination of engineering changes and upgrades introduced into the production line and modifications in the field. Specific details on shortcomings cannot be addressed in this report because they are classified.

Most of the logistical support for the MRAP is being provided by contractor personnel, with more than 1,400 government civilians and contractors supporting operations in Iraq, Afghanistan, and Kuwait. The program office is currently developing a plan to begin transitioning to military personnel provided support in early fiscal year 2011. According to program officials, readiness levels have consistently exceeded the 90 percent benchmark across all theaters of operation. As of December 2008, the readiness rate for Iraq was 93 percent, the rate for Afghanistan was 87 percent, and the overall MRAP fleet readiness was 92 percent. Program officials attributed this disparity to the austere environment, rough terrain, and repair parts distribution challenges in Afghanistan. As of October 2008, according to program officials, the time to return a vehicle to fully mission capable once repairs begin is 8.57 hours for Iraq and 7.42 hours for Afghanistan. This is much better than the required time of 15 days or less.

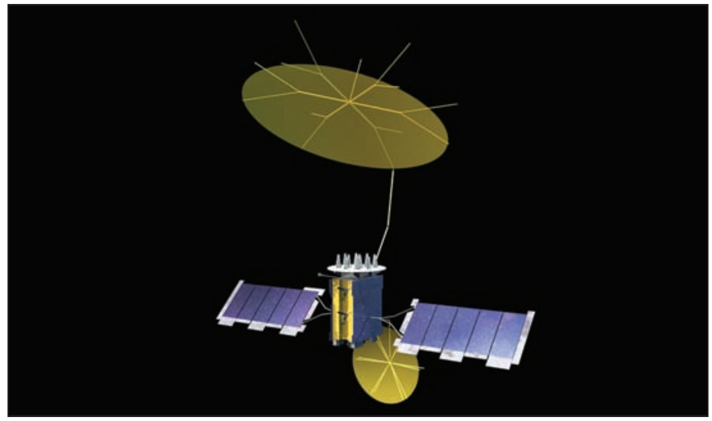
DOD has yet to make decisions on the MRAP's role in its tactical wheeled vehicle strategy, including how many of the fleet will remain on active service and how many will be stored or turned over to coalition forces. These decisions will ultimately impact the total cost of ownership. Other DOD decisions will also affect the future of the MRAP vehicle program. DOD plans to acquire and the Joint Program Office recently issued a request for proposal for a lighter vehicle with MRAP-level protection and off-road mobility. DOD is seeking mature items for production and will expect offerors to present for preliminary inspection two production representative vehicles between mid- to late-February 2009. Purchase of the vehicles for further testing will be contingent on their assessed potential to meet certain performance and safety requirements.

Program Office Comments

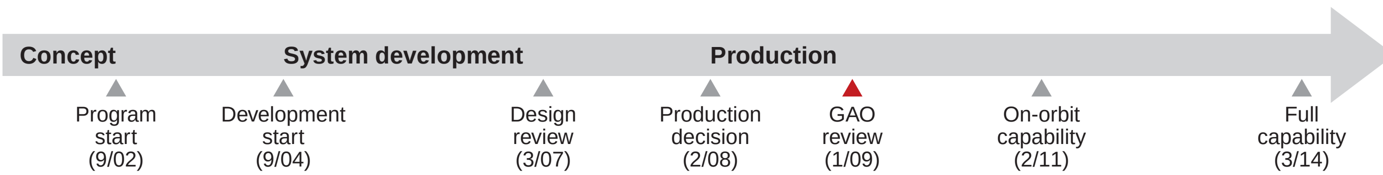
In commenting on a draft of this assessment, the Marine Corps provided technical comments, which were incorporated where appropriate.

Mobile User Objective System (MUOS)

The Navy's MUOS, a satellite communication system, is expected to provide a worldwide, multi-service population of mobile and fixed-site terminal users with an increase in narrowband communications capacity and improved availability for small terminals. It is to replace the Ultra High Frequency Follow-On (UFO) satellite system currently in operation and provide interoperability with legacy terminals. MUOS consists of a network of satellites and an integrated ground network. We assessed both the space and ground segments.



Source: Lockheed Martin, © 2008 Lockheed Martin.



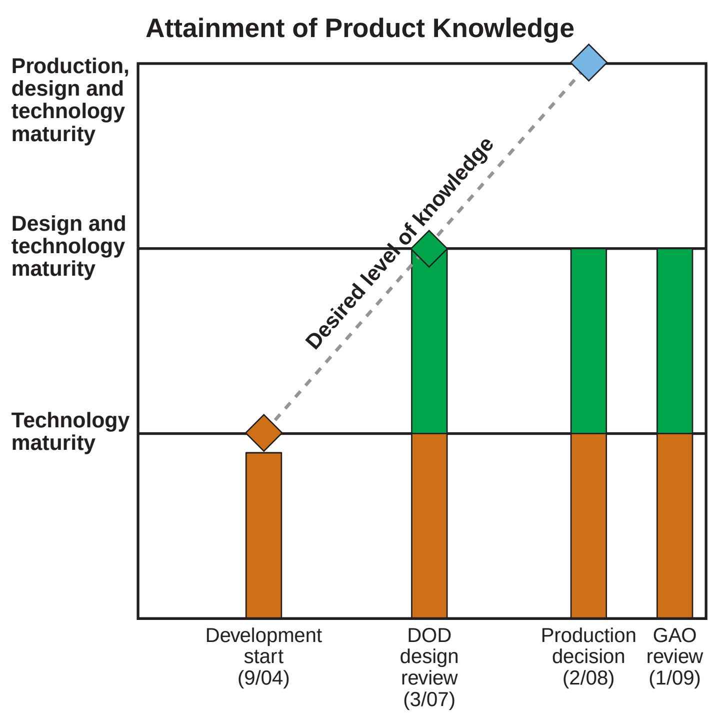
Program Essentials

Prime contractor: Lockheed Martin Space Systems
Program office: San Diego, CA
Funding needed to complete:
R&D: $1,373.3 million
Procurement: $2,393.0 million
Total funding: $3,776.6 million
Procurement quantity: 4

Program Performance (fiscal year 2009 dollars in millions)

	As of 09/2004	Latest 08/2008	Percent change
Research and development cost	$3,523.0	$3,751.3	6.5
Procurement cost	$2,931.3	$2,594.9	-11.5
Total program cost	$6,491.6	$6,411.3	-1.2
Program unit cost	$1,081.932	$1,068.547	-1.2
Total quantities	6	6	0.0
Acquisition cycle time (months)	91	102	12.1

All of the MUOS program's critical technologies are mature and the design is currently stable. We could not assess production maturity because the program does not collect statistical process control data. The delivery of MUOS capabilities has become time-critical due to the operational failures of two UFO satellites, creating a risk of a gap in communications capabilities prior to the launch of the first MUOS satellite. Additionally, the program office estimates a delay in the MUOS launch due to difficulties with the development of the space segment, such as flight unit qualification and test anomalies. These development challenges could also cause costs to grow above the current program baseline. Further, MUOS planned capabilities could be significantly underutilized because of development problems with the Joint Tactical Radio System (JTRS).



MUOS Program

Technology Maturity and Design Stability

According to the program office, all critical technologies are mature and the design is currently stable. The number of critical technologies has varied over time, but all eight current critical technologies have been demonstrated in a realistic environment. Additionally, the satellite design is stable, as all expected design drawings have been released. According to the program office, satellite weight—a design-related risk item we reported on in our last assessment—has stabilized at approximately 8,380 pounds with 86 percent of actual and qualified hardware developed. As of December 2008, there was over 350 pounds margin between the weight of the satellite and the capacity of the launch vehicle.

Production Maturity

We could not assess production maturity because the program does not collect statistical process control data. However, it is collecting and tracking data on manufacturing process defects to assess the maturity of MUOS production. According to the program office, these data for the components of the first satellite indicate high production maturity.

Other Program Issues

The importance of the first MUOS launch has increased due to the unexpected failures of two UFO satellites, one in June 2005 and another in September 2006. As a result, UHF communication capabilities are predicted to fall below the required availability level in December 2009, 15 months before the first MUOS satellite is to become operational. The MUOS program office has begun mitigation efforts to address this capability gap, including activating dual digital receiver unit operations on a UFO satellite and leasing services from a commercial vendor. The MUOS program office is also examining the feasibility of expanded digital receiver unit and dual digital receiver unit operations on the legacy payloads of the MUOS satellites.

In early 2009, the MUOS program began implementing an over-target baseline to account for program schedule delays and contractor cost increases. As a result of satellite development issues, the MUOS program office estimates an 11-month delay—from March 2010 to February 2011—in the delivery of on-orbit capability from the first satellite. According to the program office, this delay does not negatively affect the full capability date for MUOS in 2014. Further, contractor costs for space segment development have significantly increased, due to the additional labor required to address issues related to satellite design complexity, satellite weight, and satellite component test anomalies and associated rework. According to the program office, as of October 2008, space segment costs were about $278 million, or about 48 percent, over the contractor's initial estimate. Likewise, the integrated ground segment costs, which include the MUOS waveform, while essentially on schedule, was $60.3 million, or about 9 percent, over the contractor's initial estimate mainly due to software tasks requiring more effort than planned and rework.

Due to development delays in the JTRS program, the advanced communication capabilities of the MUOS satellites may initially be significantly underutilized. The lack of synchronization means that early utilization of MUOS capability will largely be limited to the legacy communications waveform. According to the MUOS program office, maintaining the MUOS schedule is critical to support legacy users. However, underutilization of the new waveform represents an inefficient use of on-orbit resources given the limited life and estimated $1.1 billion program unit cost of the MUOS satellites.

Program Office Comments

In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

MQ-9 Reaper Unmanned Aircraft System

The Air Force's MQ-9 Reaper (formerly Predator B) is a multirole, medium-to high-altitude endurance unmanned aerial vehicle system capable of flying at higher speeds and higher altitudes than its predecessor, the MQ-1 Predator A. The Reaper is designed to provide a ground attack capability to find, fix, track, target, engage, and assess small ground mobile or fixed targets. Each system consists of four aircraft, a ground control station, and a satellite communications suite.

Taken in performance of official duties as a photographer/journalist. (U.S. Air Force Photo/Master Sgt. Robert W. Valenca)
Source: http://www.af.mil/shared/media/photodb/photos/071110-F-1789V-991.jpg.

Concept		System development		Production			
Program start (1/02)	Development start (2/04)	Low-rate decision (2/08)	GAO review (1/09)	Initial capability (8/09)	Full-rate decision (3/10)	Last procurement (2015)	

Program Essentials

Prime contractor: General Atomics Aeronautical Systems Incorporated
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $199.9 million
- Procurement: $1,336.7 million
- Total funding: $1,637.8 million
- Procurement quantity: 68

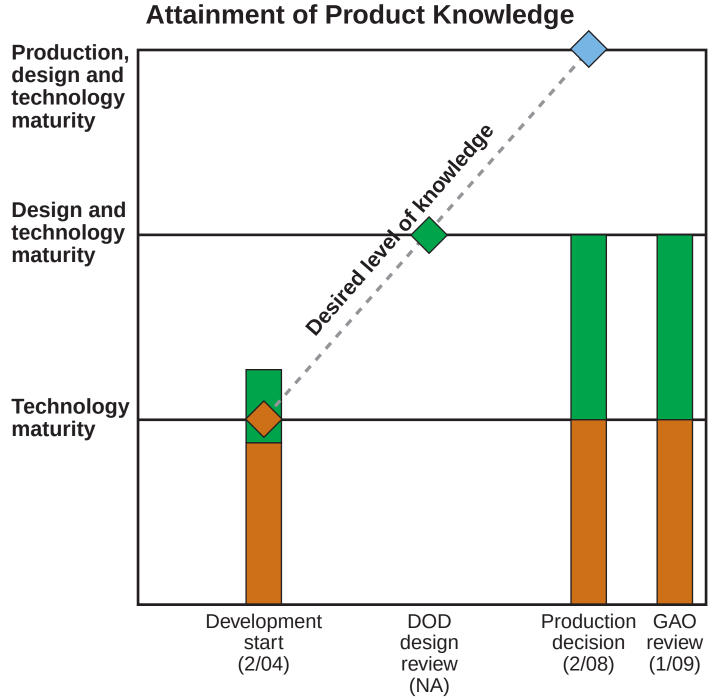
Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2004	Latest 10/2008	Percent change
Research and development cost	$195.4	$385.5	97.3
Procurement cost	$508.7	$2,405.7	373.0
Total program cost	$704.0	$2,892.4	310.8
Program unit cost	$21.330	$24.512	14.9
Total quantities	63	118	87.3
Acquisition cycle time (months)	70	66	-5.7

Latest cost and quantity data are through fiscal year 2015; earlier data go through fiscal year 2009. The Air Force could not provide comparable data. Program unit cost as of August 2004 is based on 33 aircraft.

All four of the Reaper's original critical technologies are mature. However, in 2008, the program office identified 14 technology improvements, half of which are not yet mature. Because of early fielding demands, the program did not conduct a system-level critical design review. Nevertheless, the program office estimates that over 95 percent of the design drawings have been completed. The Air Force has contracted for 37 aircraft—31 percent of the planned total. Initial operational testing was completed in August 2008. Test results indicated that the Reaper was partially mission capable. The Reaper was effective in the killer role, but issues associated with the radar and network precluded the test team from evaluating the other two key performance parameters, the hunter and the net-ready capability.

Attainment of Product Knowledge



MQ-9 (Reaper) Program

Technology Maturity

All four of the Reaper's critical technologies, the synthetic aperture radar, the multispectral targeting system, the air vehicle, and the stores management subsystem, are now mature. In its 2008 technology development strategy, the MQ-9 program office identified 14 additional technology improvements, half of which are not yet mature. These technologies (ranging from TRL 5-8) are expected to enhance the capability of existing on-board subsystems and ground control stations and will be phased into the increment-one aircraft when mature. The second increment will require other new technologies.

Design Maturity

The program office currently reports that over 95 percent of the drawings for the increment-one aircraft are complete. The design review for this increment was initially planned for September 2005. However, because the user required an early operational capability, the Air Force did not conduct a traditional system critical design review. Instead, it conducted a series of smaller incremental reviews of the early operational aircraft configurations. The next design review—for the weapons—is planned for February 2009. Program officials acknowledge that additional drawings will be needed for subsequent aircraft increments.

Production Maturity

We did not assess production maturity because the MQ-9 program does not use statistical process controls. The program uses other quality control measures such as scrap, rework, and repair to track product quality. Although the contractor has had trouble meeting its aircraft delivery dates in the past, its most recent deliveries have been earlier than planned. To date, the Air Force has contracted for 37 aircraft, 31 percent of the current planned total. The Air Force completed a manufacturing readiness assessment and determined that the production line is capable of manufacturing two aircraft per month. After its planned facilities expansion is complete, the contractor projects that it should be able to produce up to five aircraft per month.

Other Program Issues

Since its inception, the Reaper program has followed a nontraditional acquisition path highlighted by changing requirements. Within the past 2 years, total program quantities have increased from 63 to 118 aircraft, due in part to large increases in the wartime supplemental budget. Quantities may grow significantly higher because the Air Force plans to curtail production of the MQ-1 Predator aircraft and buy only MQ-9 Reapers. The system's performance requirements have also changed. Shortly after the February 2004 development decision, the user required an early operational capability that included the Hellfire missile and a digital electronic engine control. Subsequent aircraft will have upgrades to the radar, weapons, and software developments. The Reaper completed initial operational testing and was asessed as partially mission capable. It was effective in the killer role, a key performance parameter (KPP), but problems associated with radar and the network prevented testers from evaluating the other KPPs, hunter and net-ready capability. Follow-on testing has not yet been scheduled.

Program Office Comments

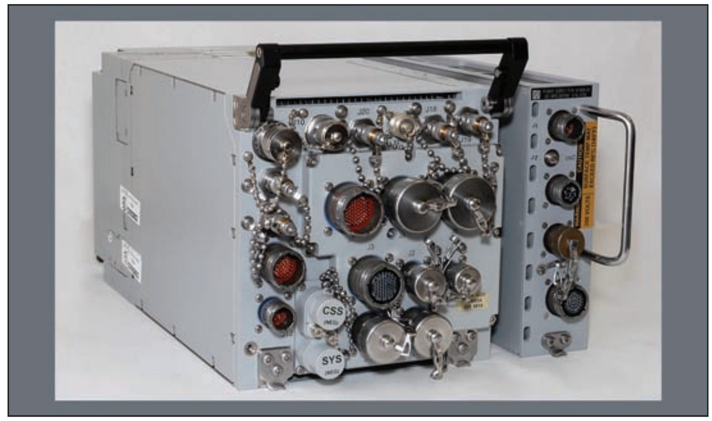
In commenting on a draft of this assessment, the Air Force stated that it was forced into a nontraditional acquisition path to rapidly meet the demands of the Global War on Terrorism. While this path has introduced inefficiencies, the Air Force stated that it has delivered effective combat capability well ahead of what would have been achievable using a traditional acquisition path. It also noted that the majority of the aircraft production to date has been the result of congressional plus-ups and direction. Program officials maintain there is manageable and accepted risk with production taking place before critical design review and operational testing within this nontraditional acquisition. An Integrated System Exercise 1 operationally assessed MQ-9 Reaper for a successful deployment. An Integrated System Exercise 2 further assessed MQ-9 in preparation of the initial operational test and evaluation.

GAO Response

Our reviews of DOD weapon systems confirm that producing a system before the completion of operational testing adds signficiant cost risk to the program. Operational testers recently determined that the Reaper was only partially mission capable due to effectiveness and suitability shortfalls. Changes needed to resolve these shortfalls could affect program cost and schedule.

Mutifunctional Information Distribution System-Joint Tactical Radio System (MIDS-JTRS)

DOD's MIDS-JTRS program is intended to transform the existing MIDS Low Volume Terminal—a jam-resistant, secure voice and data information distribution system—into a 4-channel, programmable JTRS-compliant radio that will be used in aircraft, ships, and ground stations across the military services. We assessed the development of the MIDS-JTRS core terminal and made observations on the status of the planned JTRS platform capability package, which includes an airborne networking waveform being developed by the JTRS Network Enterprise Domain.



Source: MIDS Program Office.

Program Essentials

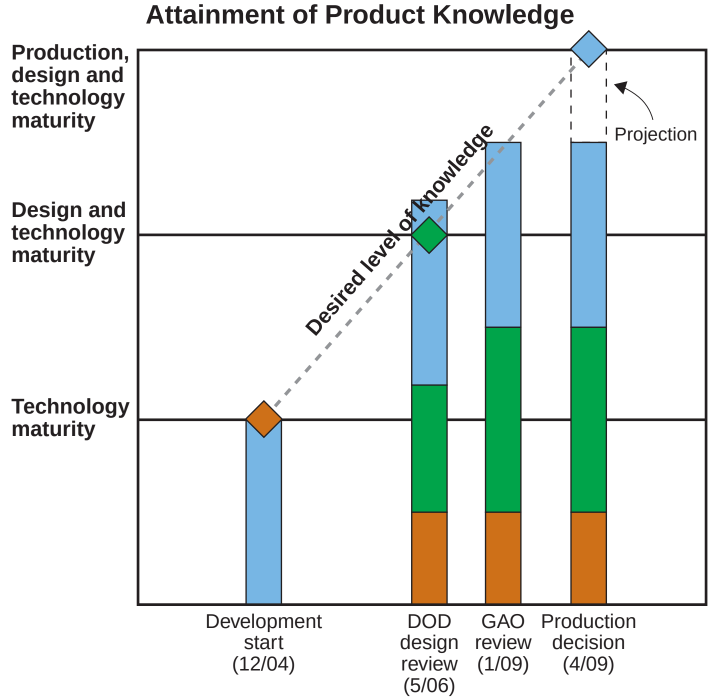
Prime contractor: Data Link Solutions, ViaSat
Program office: San Diego, CA
Funding needed to complete:
R&D: $35.9 million
Procurement: $92.5 million
Total funding: $128.2 million
Procurement quantity: 280

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2004	Latest 08/2008	Percent change
Research and development cost	$301.0	$458.5	52.3
Procurement cost	$0.0	$134.9	NA
Total program cost	$301.0	$593.2	97.1
Program unit cost	$9.406	$1.541	-83.6
Total quantities	32	385	1103.1
Acquisition cycle time (months)	50	62	24.0

All four of the MIDS-JTRS core terminal critical technologies are approaching maturity; the design appears stable; and the production processes are mature. Core terminal development models integrated into F/A-18 aircraft are now undergoing testing in an operational environment. Test results will be used to support the low-rate initial production decision. The production decision has been delayed by at least 1 year since our last assessment because of the effects of changes in the MIDS-JTRS security design. In September 2007, the JTRS Board of Directors suspended the design, development, fabrication, and testing of the JTRS platform capability package pending a determination of whether there were enough potential users among the military services to support this effort. This suspension is still in effect.

Attainment of Product Knowledge



MIDS JTRS Program

Technology Maturity

The core terminal's four critical technologies—(1) Link-16 waveform software, (2) Link-16 architectural design, (3) operating environment, and (4) programmable crypto module—are approaching maturity. However, unanticipated complexity in integrating these subsystems has caused program schedule delays. According to program officials, integration concerns are being addressed, and the critical technologies are expected to demonstrate maturity just prior to the projected low-rate initial production decision. The program office began demonstrating the terminal's capabilities in an operational environment during the first quarter of fiscal year 2008, which thus far has not disclosed any significant technical issues. Program officials stated that test results will be used to support the core terminal program's low-rate initial production decision, which has been delayed until April 2009.

Design Maturity

According to program officials, the core terminal's design is stable, as the program has released 100 percent of its design drawings to the manufacturer. However, until the maturity of the core terminal's critical technologies has been demonstrated in an operational environment, the potential for design changes remains.

The core terminal will be the first JTRS radio to undergo National Security Agency certification and it has faced challenges in meeting security requirements. Though it received National Security Agency design concurrence and over-the-air approval in an F/A-18 aircraft, understanding and implementing information security criteria caused changes in security design. The effects of the design changes were not adequately scoped into the integration schedule, which has contributed to a 1-year delay in the program's production decision. Security verification testing is ongoing, and is proceeding well, according to a program official. First article qualification testing has begun and is expected to be completed in early 2009. Air worthiness terminals are on loan to the government to support developmental and operational testing until purchased terminals are delivered.

Production Maturity

The MIDS-JTRS program has demonstrated that its two critical manufacturing processes are mature. Program officials stated that production maturity is high because the core terminal is a form, fit, and function replacement for the MIDS Low Volume Terminal and the manufacturing processes are the same as those previously employed.

Other Program Issues

The unanticipated complexity in meeting National Security Agency security requirements has resulted in development cost increases for MIDS-JTRS. A cost cap agreement with incentives was negotiated between the government and MIDS contractors to reduce the government's cost risk to complete the core terminal program. The acquisition program baseline is in the process of being updated in preparation for the low-rate initial production decision. This baseline will reflect revised schedule and cost parameters.

MIDS JTRS airborne networking waveform development has still not been authorized. In September 2007, the JTRS Board of Directors suspended the design, development, fabrication, and testing of the JTRS platform capability package, pending a determination from Joint Staff and the Assistant Secretary of Defense for Networks and Information Integration on the requirements for the future advanced airborne tactical data link. This package will allow the MIDS-JTRS radio to operate a wideband networking waveform specifically designed for low latency airborne missions. Furthermore, the JTRS Joint Program Executive Office was advised by the Deputy Under Secretary of Defense for Science and Technology to conduct an independent technical assessment of waveforms, networking, and network management approaches. These studies are not completed, and the suspension of effort on the platform capability package is still in effect.

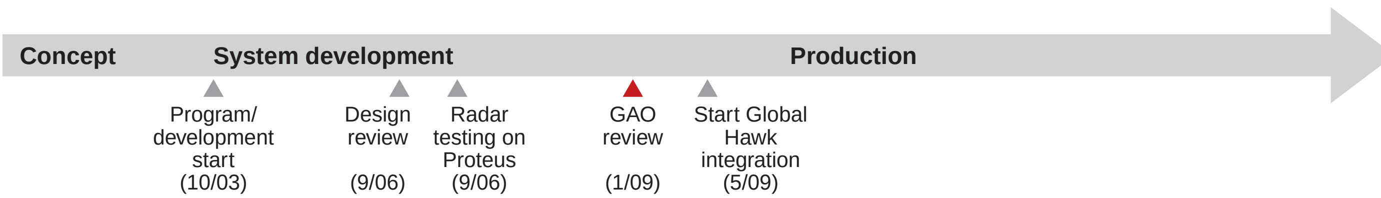
Program Office Comments

In commenting on a draft of this assessment, the MIDS-JTRS program office provided technical comments, which were incorporated as appropriate.

Multi-Platform Radar Technology Insertion Program

The Air Force's Multi-Platform Radar Technology Insertion Program (MP-RTIP) is designing a modular, scalable, two-dimensional active electronically scanned array radar for integration into the Global Hawk unmanned aerial vehicle platform. The radar will provide an improved ground moving target indicator and synthetic aperture radar imaging. The MP-RTIP program funds research, development, and test and evaluation activities only; the Global Hawk program will fund production of the radars.

Source: Northrop Grumman.



Program Essentials

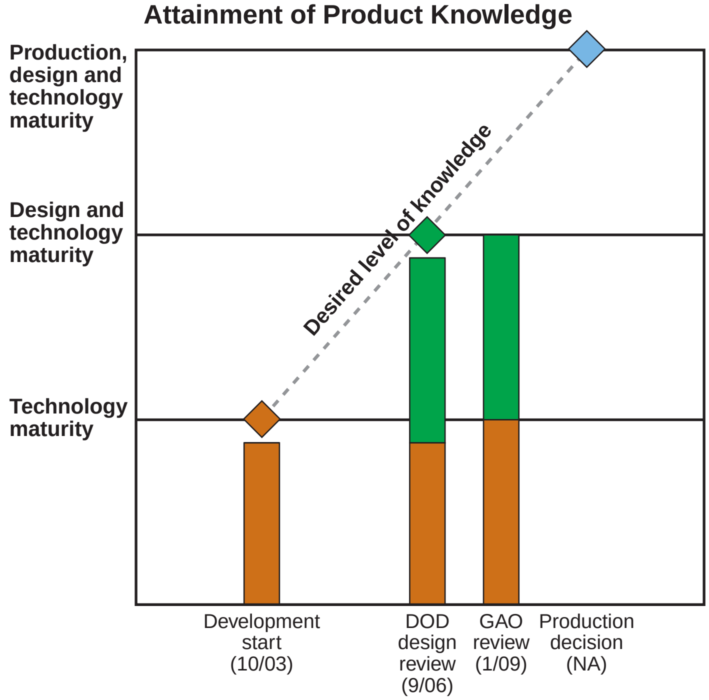
Prime contractor: Northrop Grumman ISWR
Program office: Hanscom AFB, MA
Funding needed to complete:
- R&D: $41.8 million
- Procurement: NA
- Total funding: $41.8 million
- Procurement quantity: NA

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2003	Latest 12/2007	Percent change
Research and development cost	$1,735.1	$1,334.5	-23.1
Procurement cost	NA	NA	NA
Total program cost	$1,735.1	$1,334.5	-23.1
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

All eight of MP-RTIP's critical technologies for the Global Hawk radar are mature, and the design is stable. In 2006, a Global Hawk MP-RTIP development unit was installed on a surrogate testbed aircraft (Proteus) and flight testing began in September 2006. Proteus flight testing is planned to be complete in February of 2009. According to the program office, Proteus testing completion has been delayed from the planned date of September 2007 because issues with the calibration of the radar antenna have caused significant software maturity delays. In May 2009, the MP-RTIP program plans to deliver one MP-RTIP development unit to the Global Hawk program to support developmental testing on that air vehicle. The MP-RTIP program office will support the Global Hawk program through the completion of initial operational testing, which is planned to start no later than November 2010.

Attainment of Product Knowledge



MP-RTIP Program

Technology Maturity

According to the MP-RTIP program, all eight of MP-RTIP's critical technologies for the Global Hawk radar are fully mature. In addition, the Global Hawk program office conducted a technology readiness assessment in 2008 and also found that all MP-RTIP critical technologies were fully mature.

Design Maturity

The program completed 100 percent of its planned drawings as of September 2008 and the design is stable.

Production Maturity

We did not assess MP-RTIP's production maturity because the program only consists of research, development, and test and evaluation activities; the Global Hawk program is responsible for radar production. The MP-RTIP program office, along with the contractor, Northrup Grumman, conducted two production readiness reviews to determine how well the radar was progressing toward the five production readiness criteria categories: product design and test, manufacturing operations, subcontract and material, product support and management, and management. According to program officials, all deficiencies were remedied and all action items have been closed.

Other Program Issues

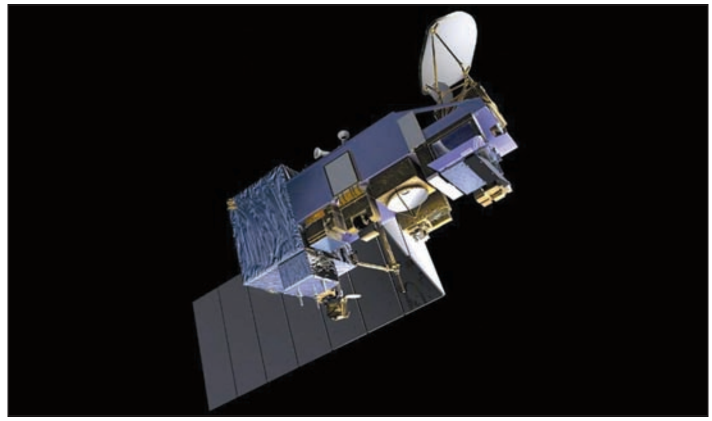
Originally, the MP-RTIP program also included the development of the Wide Area Surveillance radar for integration into a wide-body aircraft, specifically the E-10A aircraft. However, the fiscal year 2008 President's budget eliminated funding for the Wide Area Surveillance radar, and the E-10A technology development program was terminated by the Air Force in February 2007. The Senate Committee on Armed Services noted that the MP-RTIP radar should be on platforms larger than the Global Hawk in its report on the National Defense Authorization Act for fiscal year 2008. In that same report, the committee recommended an increase in funding so that the MP-RTIP could be retrofitted into the E-8 Joint Surveillance Target Attack Radar System (Joint STARS), which was the original platform designated for the radar. In fiscal year 2008, the Joint STARS Program received $85.4 million in Global War on Terror funding for the radar technology insertion program. The National Defense Authorization Act for fiscal year 2009 authorized $20 million for the MP-RTIP sensor for the Joint STARS platform. The Air Force is also considering whether additional platforms could utilize the radar.

Program Office Comments

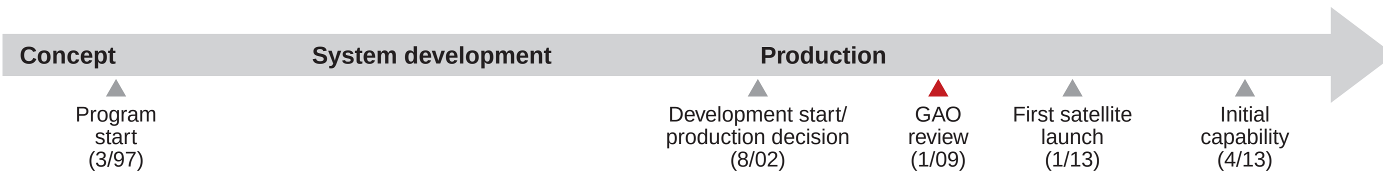
In commenting on a draft of this assessment, the Air Force concurred with our findings. The program office also provided technical comments, which were incorporated where appropriate.

National Polar-orbiting Operational Environmental Satellite System (NPOESS)

NPOESS is a tri-agency—National Oceanic and Atmospheric Administration (NOAA), DOD, and National Aeronautics and Space Administration—satellite program to monitor the weather and environment through the year 2026. Current NOAA and DOD satellites will be merged into a single national system. NOAA and DOD each provide 50 percent of the funding for NPOESS. The program consists of four segments: space; command, control, and communications; interface data processing; and the launch segment. We assessed the space segment.



Source: Courtesy of Northrop Grumman.



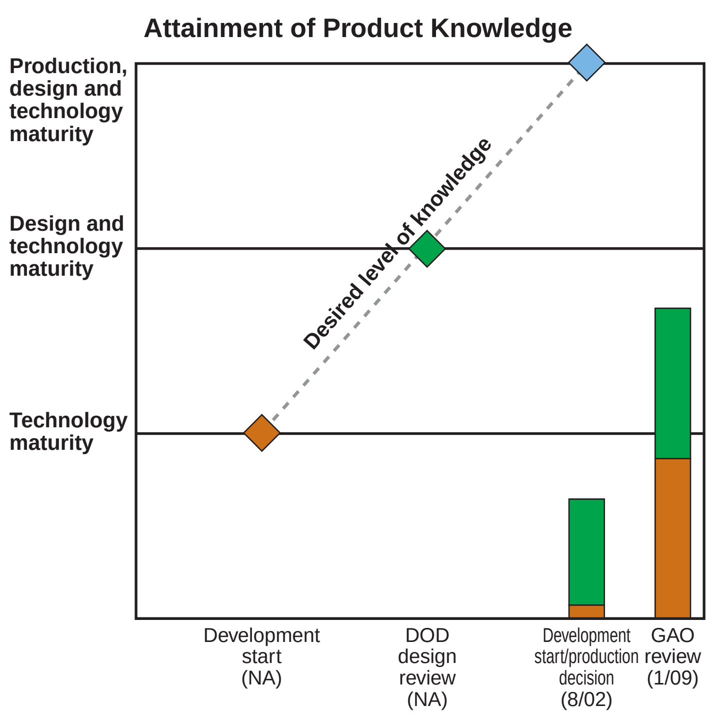
Program Essentials

Prime contractor: Northrop Grumman Space Technology
Program office: Silver Spring, MD
Funding needed to complete:
- R&D: $3,202.4 million
- Procurement: $2,879.8 million
- Total funding: $6,082.3 million
- Procurement quantity: 2

Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2002	Latest 12/2008	Percent change
Research and development cost	$5,130.2	$8,032.9	56.6
Procurement cost	$1,324.4	$2,879.8	117.5
Total program cost	$6,454.5	$10,912.6	69.1
Program unit cost	$1,075.758	$2,728.147	153.6
Total quantities	6	4	-33.3
Acquisition cycle time (months)	172	193	12.2

In August 2002, the program began development and production before achieving technology maturity, design stability, or production maturity. In July 2007, the NPOESS program was restructured in response to a Nunn-McCurdy program acquisition unit cost breach of the critical cost growth threshold. As part of the restructure, 7 of the original 14 critical technologies were removed from the program. Of the remaining technologies, all but one is mature, and the remaining technology is expected to be mature by the design review in April 2009. While the restructure's goal was to lower future cost and schedule risks, it increased the risk of a satellite coverage gap and significantly reduced data collection capabilities. Also, continuing development problems have caused further cost and schedule problems.



NPOESS Program

Technology Maturity

Only one of the NPOESS's 14 critical technologies was mature when the program began development and committed to production in August 2002. When the program was restructured as a result of cost growth in 2007, 7 of those technologies were removed from the program. Of the remaining technologies, 6 are mature, and the program projects that all will be mature by design review in April 2009.

The launch of an NPOESS demonstration satellite continues to experience delays due to development problems with a critical sensor. The launch, which was initially planned for May 2006, will not occur until at least June 2010. When in orbit, the satellite is now expected to demonstrate the performance of three sensors deemed critical—because they are to provide data for key weather products—and two noncritical sensors in an operational environment.

Design Maturity

The NPOESS program began production before achieving design stability or production maturity. As of November 2008, the program had 77 percent of an estimated 6,578 total drawings released and expects 87 percent of those drawings to be released by its planned April 2009 design review. While the NPOESS program will be approaching design stability at this review, the percentage of drawings it plans to be releasable by that point has decreased in the last year.

Production Maturity

The program office does not collect statistical process control data due to the small number of satellites to be built. However, program officials stated that the contractors track and use various metrics for subcomponent production, such as rework percentages, defect containment, and schedule and cost performance. The program does not have goals for production metrics.

Contract Management

In July 2007, the NPOESS program was restructured in response to a Nunn-McCurdy unit cost breach of the critical cost growth threshold. The program was originally estimated to cost about $6.5 billion for six satellites from 1995 through 2018. The restructured program called for acquiring fewer satellites and included an overall increase in program costs, delays in satellite launches, and deletions or replacements of satellite sensors. Specifically, the current estimated life cycle cost of the program is about $13.5 billion for four satellites through 2026—about $1 billion more than estimated last year. The increased cost reflects revisions to outdated operations and support cost estimates. As we have previously reported, the delayed launches of fewer satellites will result in reduced satellite data collection and require dependence on a European satellite for coverage during midmorning hours. There is also an increased risk of a coverage gap for the existing constellation of satellites should there be premature satellite failures or unsuccessful launches of legacy satellites. Finally, the restructured program deleted 4 of 13 instruments and reduced the functionality of four sensors. While the program has added one sensor back to the first satellite, the NPOESS system will have significantly less capability for providing global climate and space environment measures than originally planned. According to the program office, this reduced capability will not meet all the system's key performance parameters (KPP) or critical user requirements, which did not change as a result of the restructure.

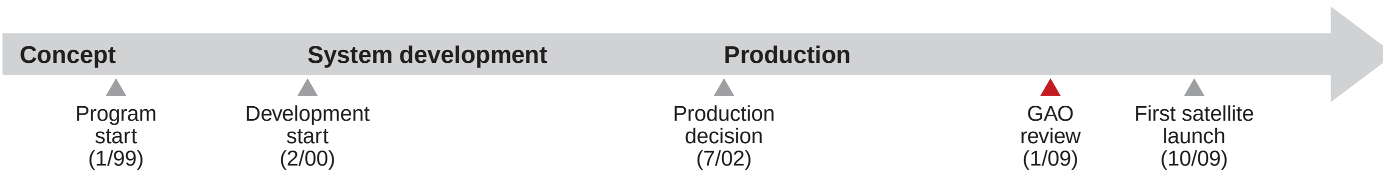
Program Office Comments

In commenting on a draft of this assessment, the NPOESS Integrated Program Office noted that while the reduced capability of the first satellite will not meet all KPPs, the second satellite will meet all KPPs. Additionally, the NPOESS Integrated Program Office provided technical comments which were incorporated as appropriate.

Navstar Global Positioning System (GPS) Space & Control

GPS is an Air Force-led joint program with the Army, Navy, Department of Transportation, National Geospatial-Intelligence Agency, United Kingdom, and Australia. This space-based radio-positioning system nominally consists of a 24-satellite constellation providing navigation and timing data to military and civilian users worldwide. In 2000, Congress began funding the modernization of Block IIR (called Block IIR-M) and Block IIF satellites. GPS also includes a control system and receiver units. We focused our review on Block IIF.

Source: GPS Wing.



Program Essentials

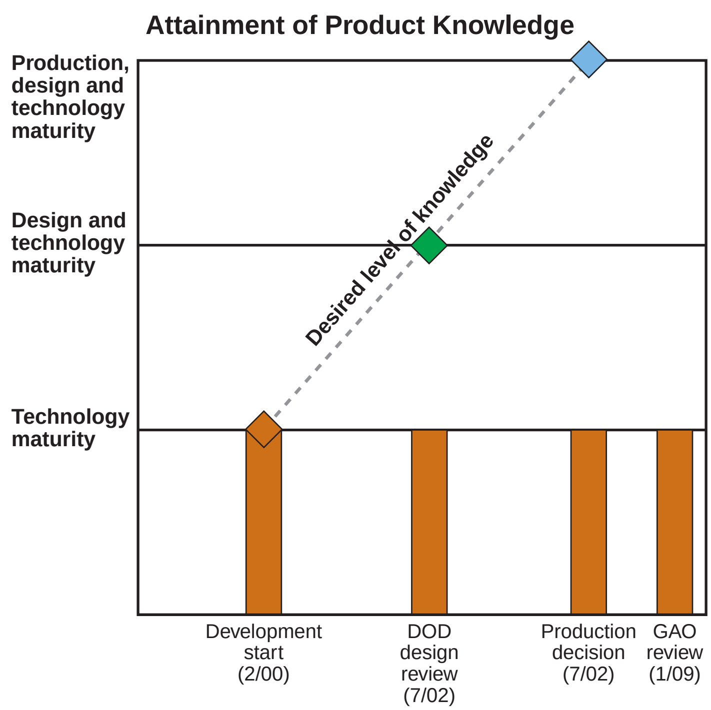
Prime contractor: Boeing for IIF, Boeing for OCS, Lockheed Martin for IIR and IIR-M
Program office: El Segundo, CA
Funding needed to complete:
R&D: $245.2 million
Procurement: $425.2 million
Total funding: $670.4 million
Procurement quantity: 0

Program Performance (fiscal year 2009 dollars in millions)

	As of 02/2002	Latest 12/2007	Percent change
Research and development cost	$2,126.4	$2,621.6	23.3
Procurement cost	$3,878.1	$4,517.3	16.5
Total program cost	$6,004.5	$7,138.9	18.9
Program unit cost	$181.956	$216.329	18.9
Total quantities	33	33	0.0
Acquisition cycle time (months)	NA	NA	NA

Total quantities include 13 IIR, 8 IIR-M, and 12 IIF satellites.

The GPS program continues to experience delays in the launch of the first Block IIF satellite and increases in program costs. The program office estimates that the launch will be delayed almost 3 years from its original date to October 2009, due to development and production problems. Specifically, technical issues with various satellite components, such as transmitters, were discovered during testing earlier this year. As a result, the program has temporarily delayed further testing to allow time for the contractor to identify the causes of the problems and take corrective actions. While the GPS Block IIF program began development with its one critical technology mature, we have not been able to assess design stability or production maturity because the contractor is not required to provide data on design drawings or statistical process control under its contract.



NAVSTAR GPS-Space & Control Program

Technology Maturity

The Block IIF critical technology-space—qualified atomic frequency standards—is mature.

Design Maturity

We could not assess design stability because according to the Program Office, the Block IIF contract does not require that design drawings be delivered to the program. Program Officials stated they assess design maturity through reviews of contractor testing, technical interchange meetings, periodic program reviews, and participation in the contractor development process.

Production Maturity

We could not assess production maturity because according to the Program Office, the Block IIF contract does not require the contractor to collect statistical process control data. Program Officials stated they assess production maturity through the same activities they conduct to assess design stability.

Other Program Issues

As a result of development and production problems, the program office now estimates the launch of the first Block IIF satellite will be delayed to October 2009—almost 3 years later than its original launch date. In the last year, the Block IIF program began its first phase of thermal vacuum testing—one of the most critical space vehicle environmental tests. It is used to determine flight-worthiness and deficiencies by subjecting the satellite to space-like operating conditions. However, technical problems discovered during thermal vacuum testing resulted in additional schedule delays and cost increases on the program. For example, a navigation signal transmitter failed during testing. According to program officials, testing was suspended in August 2008 to allow time for the contractor to identify the causes of the problem and take corrective actions, including replacing another similar transmitter. The Block IIF program is also experiencing other technical problems. For example, the satellite's reaction wheels, used for pointing accuracy, had to be redesigned adding $10 million to the program's cost. The program also had difficulty maintaining the proper propellant fuel-line temperature, and power failures delayed final integration testing.

The development schedule for the ground control segment for the Block IIF satellites also presents a risk for the program. In September 2007, the Air Force approved the transition from the legacy ground control system to the Architectural Evolution Plan (AEP), the new ground control segment that will eventually control the Block IIF satellites. The delivery of the first AEP segment allowed for the transfer of operations of current GPS satellites from the existing ground control system. In March 2008, AEP was upgraded to add the capability to control Block IIF satellites. However, according to the program office, the development schedule for the final AEP upgrade, which will ensure the integrity of the GPS signal, may not allow enough time for sufficient operational testing before the scheduled launch of the first Block IIF satellite.

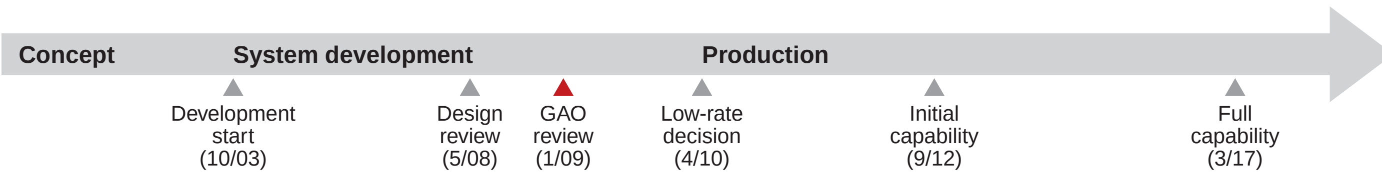
Program Office Comments

In responding to a draft of this assessment, the program office provided technical comments, which we included as appropriate.

Navy Multiband Terminal (NMT) Program

The Navy's NMT is the next-generation maritime military satellite communications terminal. Together with the Air Force's Advanced Extremely High Frequency satellite system, NMT is designed to enhance protected and survivable satellite communications to naval forces. NMT multiband capabilities will also enable communications over existing military satellite communication systems, such as Milstar, Wideband Global SATCOM, and the Defense Satellite Communications System.

Source: © 2008 Raytheon Company.



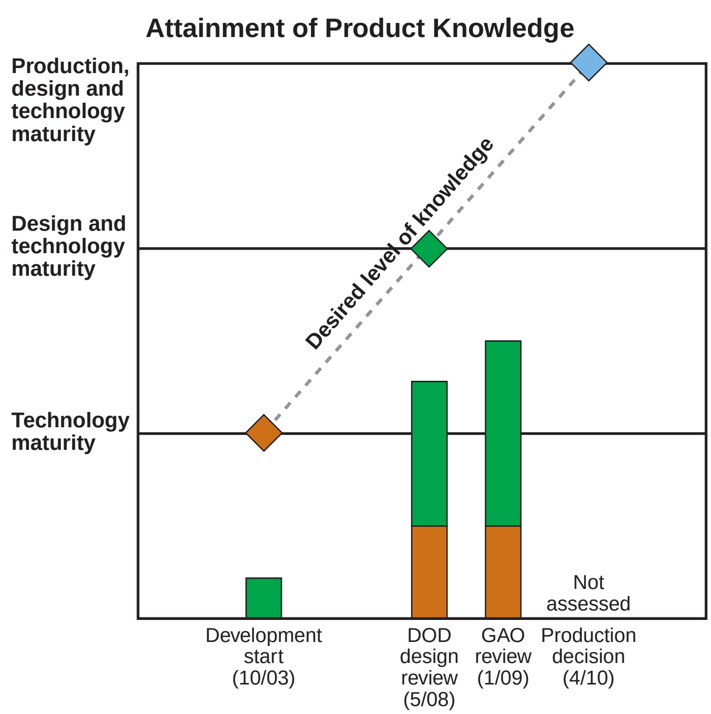
Program Essentials

Prime contractor: Raytheon
Program office: San Diego, CA
Funding needed to complete:
- R&D: $246.2 million
- Procurement: $1,294.1 million
- Total funding: $1,540.2 million
- Procurement quantity: 276

Program Performance (fiscal year 2009 dollars in millions)

	As of 12/2006	Latest 10/2008	Percent change
Research and development cost	$673.4	$648.8	-3.7
Procurement cost	$1,568.3	$1,294.5	-17.5
Total program cost	$2,241.7	$1,943.3	-13.3
Program unit cost	$6.732	$6.392	-5.0
Total quantities	333	304	-8.7
Acquisition cycle time (months)	107	107	0.0

The NMT program's two critical technologies are nearing maturity and the program office expects them to reach full maturity before the production decision in April 2010. The NMT's design is stabilizing. About 70 percent of the design drawings were released at the critical design review. The Navy expects to release more than 90 percent of the drawings by December 2008. The Navy has also identified critical manufacturing processes—a first step in assessing production maturity—and began to produce engineering development models in May 2008. According to program officials, the NMT's full operational capability will be delayed 2 years to 2017 due to changes in the NMT's procurement and installation schedule that were made to align the program with the naval operations resources and objectives.



NMT Program

Technology Maturity

The NMT program's two critical technologies—a multi-band antenna feed and monolithic microwave integrated circuit power amplifiers for Q-band and Ka-band communication frequencies—are nearing maturity, according to a June 2008 Office of Naval Research technology readiness assessment. The program office expects these technologies to be fully mature before the production decision in 2010. According to the program office, the backup technologies are older versions of the same technologies, but the challenge will be to repackage them in a more efficient form for use in the terminals if they are needed.

Design Maturity

The NMT's design is stabilizing. Program officials reported that at its May 2008 design review about 70 percent of NMT drawings were releasable to manufacturing. While approximately 300 drawings remain to be released, the program office expects that more than 90 percent of the total expected drawings will be released by December 2008. The program has also released all of the technical data packages necessary to build the program's engineering development models. The program office does not expect significant additional drawings at production, however further design work could be necessary as the program tests its engineering development models. The NMT program held an earlier design review in May 2005 for NMT prototypes from two contractors, which were competing to build the engineering development models. DOD has stated that having competing contractors produce prototypes to demonstrate key systems elements is a good practice for lowering a program's technical risk, among other benefits.

The NMT program's software lines of code have significantly increased since development start to accommodate Software Communications Architecture requirements. Currently, software integration testing is approximately 60 percent complete and almost 70 percent of the defects detected have been resolved.

Production Maturity

The Navy has identified three critical manufacturing processes—a first step in assessing production maturity—for the NMT program. Since production has yet to begin, statistical process control data are not yet available for NMT. The three criticial manufacturing processes were identified during the program's June 2008 technology readiness assessment and are related to the Q-band and Ka-band monolithic microwave integrated circuits and the Q/Ka radome. Work on engineering development models began at the conclusion of critical design review in May 2008.

Other Program Issues

The NMT program may encounter challenges in developing and fielding the system. The full capability of the NMT program depends upon the successful launches of the Advanced Extremely High Frequency (AEHF) satellites, which are experiencing delays. Specifically, the AEHF program is anticipating that the first satellite launch and initial capability will slip by 2 years to 2010 and 2013, respectively. According to NMT program officials, delays with AEHF will directly affect the ability of the NMT program to test the new higher data rate communications capability that AEHF will provide. However, these officials stated that they continue to work closely with the AEHF program office to identify other opportunities for testing this capability and the systems infrastructure. Despite the AEHF delays, the NMT program stated that the terminal can provide value to the fleet upon fielding by accessing existing satellite communication systems such as Milstar, Wideband Global SATCOM, and the Defense Satellite Communications System. The NMT program is also anticipating a 2-year slip in its full operational capability. NMT program officials stated that this delay is necessary to align the program with the naval operations resources and objectives and is due to changes in NMT's procurement and installation schedule.

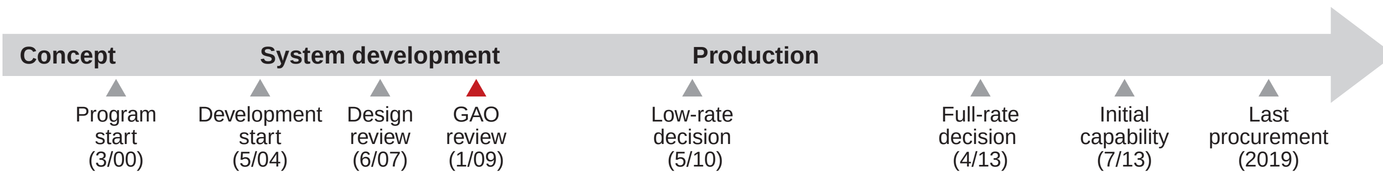
Program Office Comments

In commenting on a draft of this assessment, the Navy stated that the NMT program is being executed well to provide deployed naval commanders with assured access to secure, protected command and control and communication capabilities to support the exchange of warfighter critical information. It will support the Navy's Net-Centric FORCEnet architecture and act as an enabler for transforming operational capability available to the warfighter. The Navy also provided technical comments, which we incorporated as appropriate.

P-8A Poseidon Multi-mission Maritime Aircraft

The Navy's Multi-mission Maritime Aircraft (P-8A), a Boeing 737 commercial derivative, is the replacement for the P-3C. Its primary roles are persistent antisubmarine warfare; anti-surface warfare; and intelligence, surveillance, and reconnaissance. The P-8A shares an integrated maritime patrol mission with the Broad Area Maritime Surveillance Unmanned Aerial System and the EPX (formerly the Aerial Common Sensor). These systems are intended to operate independently or in tandem to support the Navy's maritime warfighting capability.

Source: © 2008 Boeing.



Program Essentials

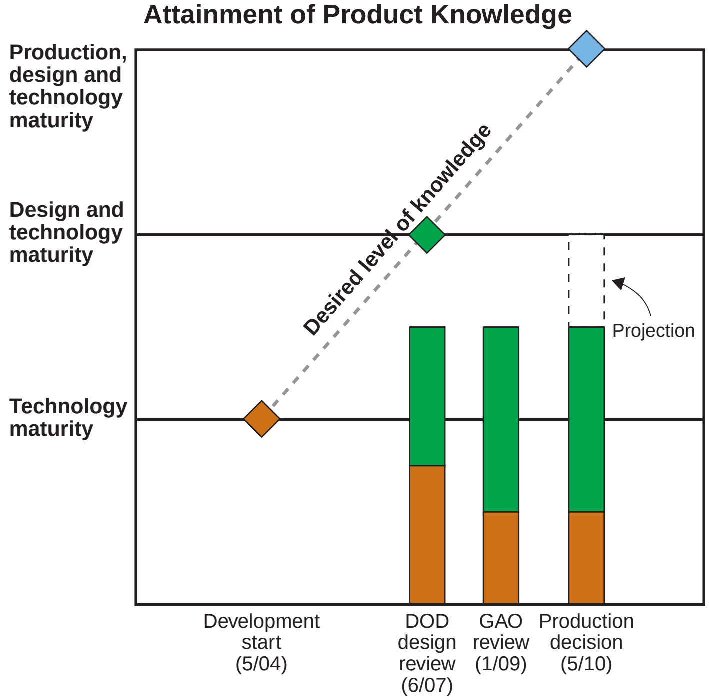
Prime contractor: The Boeing Company
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $3,324.8 million
- Procurement: $22,489.2 million
- Total funding: $25,933.7 million
- Procurement quantity: 108

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2004	Latest 08/2008	Percent change
Research and development cost	$7,274.1	$6,990.6	-3.9
Procurement cost	$22,566.9	$22,489.2	-0.3
Total program cost	$29,974.0	$29,621.9	-1.2
Program unit cost	$260.643	$262.141	0.6
Total quantities	115	113	-1.7
Acquisition cycle time (months)	160	160	0.0

The P-8A program entered development with none of its critical technologies mature. Since then, the program has made several revisions to its critical technologies. One of the two current critical technologies is mature; the other, the Hydro-Carbon Sensor, is expected to reach maturity by September 2009. In October 2008, almost all of the expected design drawings had been released. However, the design may not be stable until the program completes technology development and developmental testing. The program has initiated fabrication of test aircraft, with the first scheduled to be delivered in August 2009. A 2-month strike by Boeing machinists in 2008 may result in schedule delays and increased costs. The P-8A has already experienced a $1.4 billion contract cost increase, and is currently managing weight growth to ensure that the aircraft will meet its key performance requirements.

Attainment of Product Knowledge



P-8A Program

Technology Maturity

The program has revised its critical technologies since entering development in May 2004. First, it replaced two technologies with less capable but more mature backups which will still meet P-8A requirements. Next, it recategorized the integrated rotary sonobuoy launcher as a developmental risk. Developmental testing for this technology has been completed, but additional qualification testing may be needed after the production decision. As a result, it may not be fully mature prior to production and could lead to delays should design changes be necessary. The Magnetic Anomaly Detector Control Surface Compensation Algorithms, added as a critical technology last year, have been removed from the design, along with the Magnetic Anomaly Detector antenna. According to program officials, the existing system will meet the required performance specifications. In addition, the ESM Digital Receiver, being leveraged from the EA-18G program, is considered mature. Finally, the Hydro-Carbon Sensor, designed to detect fuel vapors, was added as a critical technology during a September 2008 technology readiness assessment. While the sensor is mature in ground-based applications, it has not been previously used in an aircraft.

Design Maturity

According to P-8A officials, the program has released 96 percent of the total expected design drawings to the manufacturer. However, the potential for design changes remains while the program demonstrates the maturity of critical technologies, completes testing of key subsystems, and manages weight growth. Weight growth previously affected the aircraft's ability to meet key performance requirements for range and endurance. However, a program-initiated effort reduced the estimated aircraft weight by 3,500 pounds. Current weight growth projections for the remainder of the program project a 1,500 pound favorable margin at completion.

Production Maturity

Since last year, the program has begun fabrication of test aircraft and the first is to be delivered in August 2009. Original plans called for seven test aircraft, but the seventh aircraft has been cut from the program, in part to cover increases in contract costs. In addition, the first test aircraft will not be fully configured as originally planned. The second and third test aircraft will support combined developmental and operational testing and will be fully mission capable; however, they are not production representative prototypes. Only the final three test aircraft will be fully configured, fully mission capable, integrated, production representative prototypes. They will be built in phase II of the program's system design and demonstration and will be used to complete operational testing. Phase II will not begin until after the low-rate initial production decision in May 2010.

Other Program Issues

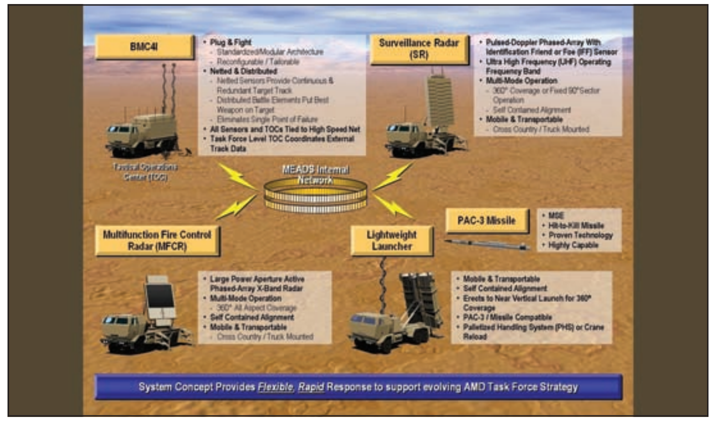
A 2-month strike at Boeing in 2008 may result in additional costs and delays in test aircraft deliveries. Program officials stated they plan to make trade-offs within the program to pay for strike-associated costs. Although the NAVAIR cost analysis division recommends that the program should have 10 percent of the budget for work remaining in management reserve, as of August 2008, the program office only had about 5 percent in management reserve. Development contract costs have already risen from $3.9 billion to $5.3 billion as a result of delays in design drawing release and additional costs to mitigate software development risks. Despite the cost increases and an expected 7-month delay in test aircraft delivery, the program still plans to meet the cost and schedule targets in its program baseline.

Program Office Comments

The program continues to manage the critical technologies. The program has continually assessed the technologies comprising the P-8A in order to identify new candidate critical technologies that require additional management attention. The maturation of the P-8A technologies is on schedule to support the System Development and Demonstration phase. The airplane remains approximately 60-65 percent common with the commercial 737-800 baseline. Although contract costs have grown since the original proposal, they still remain below the Milestone B cost estimates. The program continues to meet or exceed the cost, schedule, and performance parameters defined in the P-8A Acquisition Program Baseline Agreement.

PATRIOT/MEADS Combined Aggregate Program (CAP) Fire Unit

The Army's Patriot/Medium Extended Air Defense System (MEADS) Combined Aggregate Program transitions the Patriot missile system to MEADS. MEADS is intended provide, low- to medium-altitude air and missile defense to counter, defeat, or destroy tactical ballistic missiles, cruise missiles, or other air-breathing threats. MEADS is being developed by the United States, Germany, and Italy. We assessed the MEADS fire unit, including launchers, radars, battle management component, and launcher reloaders. We did not assess the Patriot missile.



Source: US MEADS National Product Office.

Concept | System development | Production

- Program/ development start (8/04)
- GAO review (1/09)
- Design review (2/10)
- Initial production decision (11/12)
- Initial capability (9/17)

Program Essentials

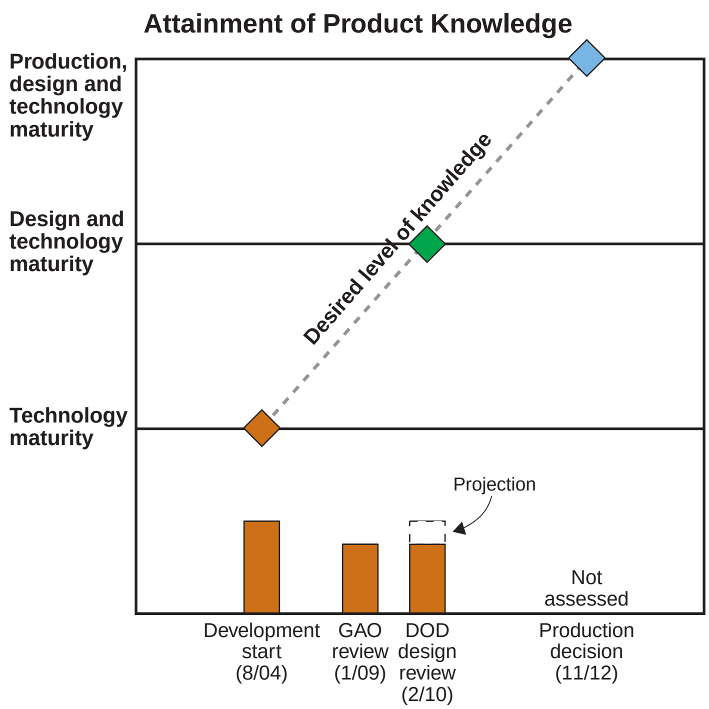
Prime contractor: MEADS International
Program office: Huntsville, AL
Funding needed to complete:
R&D: $3,789.8 million
Procurement: $13,044.0 million
Total funding: $16,833.8 million
Procurement quantity: 48

Program Performance (fiscal year 2009 dollars in millions)

	As of 08/2004	Latest 12/2007	Percent change
Research and development cost	$5,126.6	$4,840.6	-5.6
Procurement cost	$13,575.2	$13,044.0	-3.9
Total program cost	$18,701.8	$17,884.6	-4.4
Program unit cost	$389.620	$372.596	-4.4
Total quantities	48	48	0.0
Acquisition cycle time (months)	157	157	0.0

Program essentials: MEADS officials will rebaseline the program's cost and schedule in 2009 to reflect changes in the program related to the Army's Integrated Air and Missile Defense program.

The MEADS fire unit's four current critical technologies have not advanced in maturity since development started in 2004 and will not be fully mature until the production decision in 2012. In 2008, the MEADS program withdrew three technologies from its previous list of six critical technologies, reduced the technology readiness level of one critical technology, and added one new technology. The program has not reported any design knowledge, but it did hold a preliminary design review in 2008. MEADS officials will need to rebaseline the program's cost and schedule in 2009 because the development of its common battle management component is being transferred to the Integrated Air and Missile Defense (IAMD) project office. The program has also experienced delays due to developmental issues surrounding MEADS radars.



PATRIOT/MEADS CAP Fire Unit Program

Technology Maturity

The MEADS fire unit's four current critical technologies—launcher electronics, low noise exciter, Battle Management Command, Control, Communications, Computers and Intelligence (BMC4I) software requirements, and fire control transmit/receive module—have not advanced in maturity since development started in 2004. In 2008, the MEADS program did not report three of its original six technologies—Patriot Advanced Capability-3 missile integration, cooling system, and slip ring—as critical. However, the program still employs these technologies and their nearing maturity status has not changed during the last year. The program added the BMC4I software requirements as a critical technology which, along with the low noise exciter, is nearing maturity. The technology readiness level of the launcher electronics was reduced from mature to nearing maturity due to design changes made by the contractor. The fire control radar transmit/receive module is still reported as being immature. The program office estimates that all four current technologies will be nearing maturity at its February 2010 design review and be fully mature by the start of production in 2012. There are no backup technologies for any of the MEADS critical technologies.

Design Stability

We could not assess MEADS design stability because the number of releasable drawings and total drawings expected was not available. According to the program, the total number of drawings is still not known because the program just completed its preliminary design review in 2008. Program officials indicated that the design is currently being assessed through the integrated product team process, working groups, and design reviews. The MEADS fire unit's critical design review has been delayed from October 2009 to February 2010 due to developmental issues with anti-jamming capability and radar weight.

Other Program Issues

Elements of the Patriot/MEADS Combined Aggregate Program will need to be rebaselined if the Army's IAMD project office receives approval to start development on the BMC4I program in 2009 as planned. In accordance with a 2006 Army initiative, that project office is leading the development effort of a battle management component that will provide a common battle management system for MEADS and other Army air and missile defense systems. As a result, the development of the MEADS common battle management component is being transferred to the IAMD project office.

Additionally, a DOD official verified that the National Armaments Directors of the MEADS partner nations have directed the NATO MEADS Management Agency (NAMEADSMA) to develop plans to restructure the MEADS development program. NAMEADSMA is working with the program's prime contractor, MEADS International, on a contract modification to execute this restructure with a target date for signature of March 6, 2009.

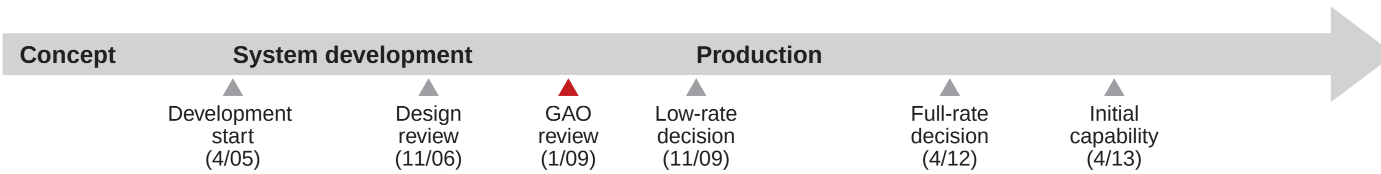
Program Office Comments

The Army concurred with the overall top-level assessment of the MEADS program and stated that the critical technologies assessed continue to be areas of intense program management focus. It noted that risk mitigation plans have been developed and the recently-completed preliminary design review resulted in better understanding of the design maturity. Additionally, the Army noted that international program partners and management are considering a number of measures, such as more time before critical design review and increased integration time overall, to increase the program's probability of success. The Army stated that, at the system-level critical design review in 2010, it expected the design work in the critical technologies to be mature enough to support fabrication of the prototypes necessary to demonstrate the system's capabilities.

Extended Range/Multiple Purpose Unmanned Aircraft System (UAS)

The Army expects its Extended Range / Multiple Purpose Unmanned Aircraft System, Sky Warrior, to fill a capability gap for an unmanned aircraft system at the division level. The system will include 12 aircraft, ground control stations, ground and air data terminals, automatic takeoff and landing systems, and ground support equipment. The Army plans for Sky Warrior to operate alone or with other platforms such as the Longbow Apache helicopter and perform missions including reconnaissance, surveillance, and target acquisition and attack.

Source: General Atomics Aeronautical Systems, Inc.



Program Essentials

Prime contractor: General Atomics
Program office: Huntsville, AL
Funding needed to complete:
R&D: $236.7 million
Procurement: $1,463.1 million
Total funding: $1,854.2 million
Procurement quantity: 7

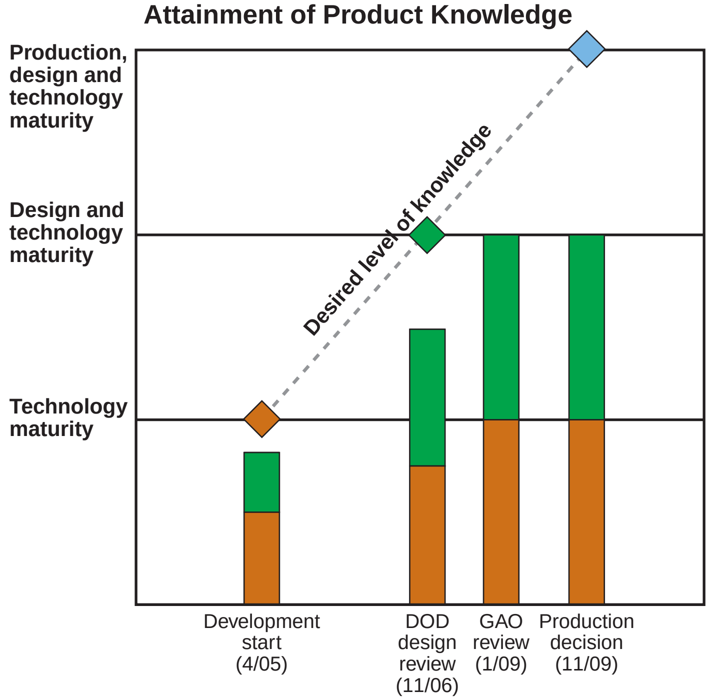
Program Performance (fiscal year 2009 dollars in millions)

	As of 04/2005	Latest 08/2008	Percent change
Research and development cost	$333.1	$568.5	70.7
Procurement cost	$647.5	$1,614.2	149.3
Total program cost	$980.5	$2,339.2	138.6
Program unit cost	$196.108	$194.937	-0.6
Total quantities	5	12	140.0
Acquisition cycle time (months)	50	96	92.0

Cost and quantities shown are from program inception through fiscal year 2015. Cost and schedule are subject to change due to a planned March 2009 acquisition rebaseline.

According to the program office, the four Sky Warrior critical technologies are mature, and the design is stable. The office stated that two technologies nearing maturity last year, the airborne Ethernet and tactical control data link, have been demonstrated in a realistic environment. The total number of drawings increased to some 39 percent more than projected at the 2006 design review; however, all drawings now have been released to manufacturing. The program's low-rate production decision has been delayed by over a year to realign the program to address nearer-term priorities. The Sky Warrior contractor uses statistical process controls to monitor production processes but not in a format that would allow us to assess production maturity. The program is expected to combine with the Air Force's Predator program and have a new acquisition baseline in March 2009.

Attainment of Product Knowledge



Sky Warrior Program

Technology Maturity
According to the program office, the four Sky Warrior critical technologies now are mature. Two technologies, the heavy fuel engine and automatic takeoff and landing system, were mature last year. The office indicates that two technologies nearing maturity last year, the airborne Ethernet and tactical control data link, now have been demonstrated in a realistic environment. These technologies were at low levels of maturity in a laboratory environment when the program began development in 2005. The program office indicated that the increased maturity of the critical technologies reflects the results of testing and operational use. The technologies have been demonstrated on the Block 1 aircraft, which is intended to be the final version of the Sky Warrior.

Design Maturity
The Sky Warrior's design appears stable. Due to requirements changes, redesign, and technology improvements, the total number of drawings is some 39 percent more than the program office projected at the 2006 design review. However, all drawings have now been released to manufacturing.

Production Maturity
We could not assess Sky Warrior's production maturity. According to the program office, the contractor uses statistical process controls to monitor production processes, but these data are not in a format that would allow us to assess production maturity. The contractor employs global technology standards per the International Standards Organization as its method for monitoring, controlling, and improving processes. The program office employs measurements related to design stability, infrastructure tooling, test equipment, facilities, and materials and personnel training to assess production maturity. The program's low-rate production decision was delayed from July 2008 to late 2009 as part of a Secretary of Defense-directed effort to surge certain assets for fielding.

Other Program Issues
The Sky Warrior program office anticipates a new acquisition baseline by the end of March 2009. According to the Army, the program was realigned to respond to a Secretary of Defense directive to field the capability as soon as possible. At this direction, the Army will field two "Quick Reaction Capability" systems. The first of those systems is to be fielded in 2009. This reprioritization had an effect on the rest of the Sky Warrior program. System development and demonstration has been extended by about 2 years, and the award of the low-rate initial production contract has been delayed by over 1 year.

Additionally, in September 2007, DOD issued a memorandum directing that the Predator and Sky Warrior programs be combined into a single acquisition program in order to achieve common development, procurement, sustainment, and training activities and migrate to a single contract. In May 2008, DOD reinforced this direction and stated that progress towards these objectives was not fast enough, and that there was significantly more work to be done to complete the effort. DOD directed the programs to present a progress update on their efforts in January 2009.

Program Office Comments
In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate. Additionally, the Army noted that it believes use or nonuse of statistical process control does not preclude production maturity assessment. It also stated that it will conduct a production readiness review in fiscal year 2009 to support the Sky Warrior production decision, and that this review will provide a reflection of production maturity. Furthermore, the Army indicated that the Ethernet as a technology had been mature for several decades but was designated a critical technology early in the program because it had not been demonstrated in an unmanned aircraft. The Army also stated that the direction to combine the Sky Warrior and Predator programs into a single acquisition program and contract will result in a common airframe and ground control station. According to program officials, there will be no joint program office, and each service will maintain a separate program office.

Space Based Infrared System (SBIRS) High

The Air Force's SBIRS High satellite system is intended to meet requirements for missile warning, missile defense, technical intelligence, and battlespace awareness missions. A planned replacement for the Defense Support Program, SBIRS High is a constellation of four satellites in geosynchronous earth orbit (GEO), two sensors on host satellites in highly elliptical orbit (HEO), and fixed and mobile ground stations. In 2007, two replenishment HEO sensors were authorized for procurement. We assessed the space segment.

Source: © 2007 Lockheed Martin Corporation.

Concept	System development		Production				
Program start (2/95)	Development start (10/96)	Design review/ production decision (8/01)	First sensor delivery (8/04)	Second sensor delivery (9/05)	GAO review (1/09)	First satellite delivery (11/09)	Second satellite delivery (11/10)

Program Essentials

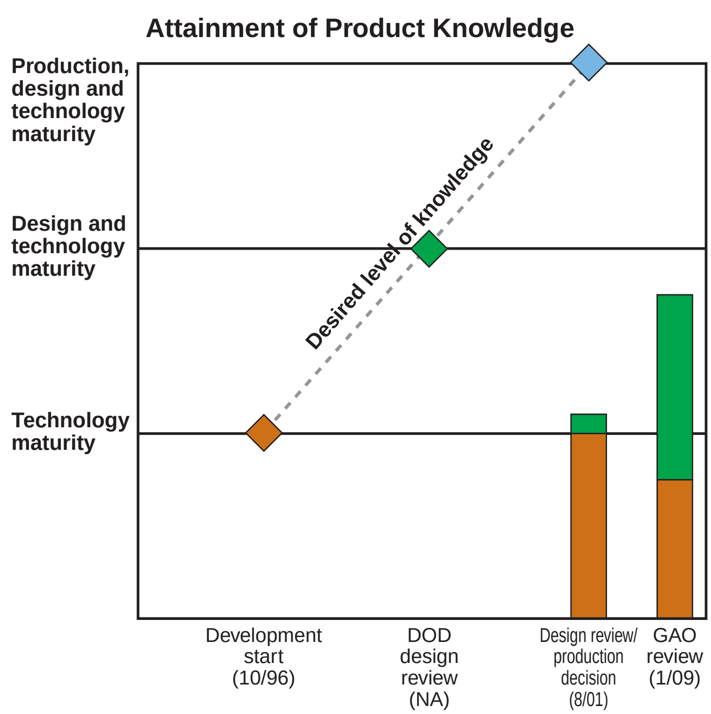
Prime contractor: Lockheed Martin Space Systems Company
Program office: El Segundo, CA
Funding needed to complete:
R&D: $1,822.6 million
Procurement: $2,160.2 million
Total funding: $4,030.7 million
Procurement quantity: 2

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/1996	Latest 12/2007	Percent change
Research and development cost	$4,220.4	$9,371.9	122.1
Procurement cost	$0.0	$2,595.4	NA
Total program cost	$4,427.4	$12,209.6	175.8
Program unit cost	$885.484	$3,052.406	244.7
Total quantities	5	4	-20.0
Acquisition cycle time (months)	TBD	TBD	TBD

The 1996 data show no procurement cost as the Air Force planned to use research and development funds to buy all five satellites. We could not calculate cycle time because the program stopped reporting an initial operational capability date in 2006.

Two of the SBIRS High program's three critical technologies are mature—a lower level of maturity than last year. The program's design is considered stable because about 97 percent of the total expected drawings are releasable. However, the program has experienced design-related problems, especially with the flight software, and more could still emerge. We could not assess production maturity. After delays of 18 and 21 months, two HEO sensors have been delivered. According to program officials, the first sensor's on-orbit performance is exceeding expectations. Program costs have increased due to software development problems on the first GEO satellite. The Air Force estimates that the first GEO satellite launch will be delayed an additional 15 months from September 2008 to December 2009. However, this estimate is optimistic and additional schedule delays and cost increases are likely.



SBIRS High Program

Technology Maturity

Two of three critical technologies are mature—a lower level of maturity than last year. The program previously reported that all three critical technologies were mature, but it recently split on-board processing into two components, payload and spacecraft. While the on-board processing technology for the payload is mature, the spacecraft component has not been fully developed and tested.

Design Maturity

Design is considered stable since about 97 percent of expected design drawings are releasable. However, the program has experienced design-related problems and more could emerge. For example, the flight software that controls the health and status of the space vehicle was found to be inadequate when it unexpectedly failed during testing in 2007. In April 2008, independent experts approved a new software design. DOD estimates the design changes will delay the first satellite launch at least 15 months to December 2009 and increase costs by about $414 million. Further cost increases and schedule delays are likely. In September 2008, we reported that the flight software development schedule is ambitious, due in part to concurrent systems engineering and software development, a productivity assumption that has not yet been demonstrated on this program, the significant amount of work remaining, and inadequate schedule margin. According to the Air Force, about 60 percent of testing is complete on the first GEO satellite with development, integration, and test activities continuing. As these activities are completed, further design problems may be discovered.

Production Maturity

We could not assess production maturity because the contractor does not collect statistical process control data. The program tracks and assesses production maturity by reviewing monthly test data and updates.

Other Program Issues

The SBIRS High program remains at risk for cost and schedule growth. Defense Contract Management Agency (DCMA) assessments indicate that the contractor's cost and schedule performance are high risks. DCMA is currently projecting a $103 million cost overrun at contract completion, and that amount is growing. Further contractor cost increases and schedule delays are expected due in part to unanticipated rework, the software redesign, and delays in integration and test activities.

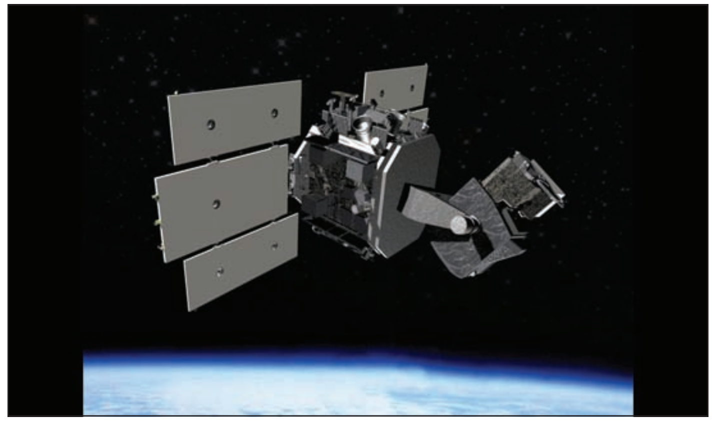
The explanatory statement accompanying the DOD appropriations act for fiscal year 2009 recommended that DOD begin procurement of a fourth and fifth GEO satellite in the fiscal year 2010 budget request. The program intends to award a follow-on production contract in June 2009 that would bundle production of the third and fourth GEO satellites and two additional HEO sensors. If a fifth GEO satellite is funded, the program plans to award a contract to its current lead contractor using other than full and open competition. The explanatory statement also recommended not providing funding for the SBIRS High follow-on development effort—called Third Generation Infrared Surveillance, or 3GIRS—and instead an additional $75 million was appropriated to the Operationally Responsive Space budget for infrared sensor payload development and demonstration. The 3GIRS effort has continued to pursue risk reduction and technology maturation for new infrared sensors, including plans to test a prototype sensor in space on a commercial host satellite in 2010.

Program Office Comments

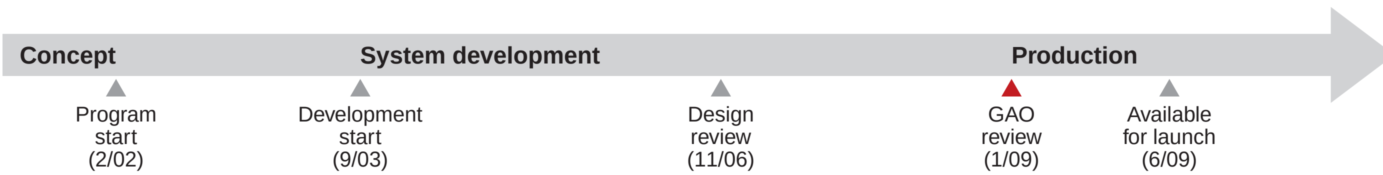
The program office stated that the first HEO sensor is operational, and on-orbit testing to date of the second HEO sensor has been successful. Additionally, development of the first two GEO satellites has made significant progress. For example, flight software development is nearly complete with delivery scheduled for March 2009. At that time, the program intends to re-assess the program schedule. Furthermore, it stated that ground software development activities are on track. Activities this year will focus on testing the first GEO satellite in a space-relevant environment. The program office also provided technical comments, which were incorporated as appropriate.

Space-Based Space Surveillance Block 10

The Air Force's Space Based Space Surveillance (SBSS) Block 10 satellite is intended to provide a follow-on capability to the Midcourse Space Experiment / Space Based Visible sensor satellite, which ended its mission in July 2008. SBSS will consist of a single satellite and associated command, control, communications, and ground processing equipment. The SBSS satellite is expected to operate 24 hours a day, 7 days a week, to collect positional and characterization data on earth-orbiting objects of potential interest to national security.



Source: Boeing.



Program Essentials

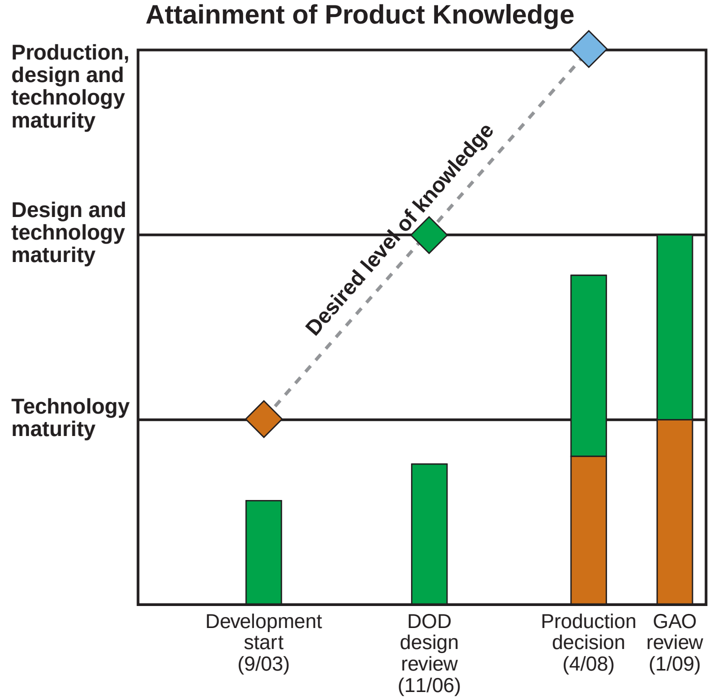
Prime contractor: Ball Aerospace, Boeing, Northrop Grumman Mission Systems
Program office: Los Angeles AFB, CA
Funding needed to complete:
- R&D: $248 million
- Procurement: NA
- Total funding: $248 million
- Procurement quantity: 0

Program Performance (fiscal year 2009 dollars in millions)

	As of 01/2008	Latest 09/2008	Percent change
Research and development cost	$842.3	$857.6	1.8
Procurement cost	NA	NA	NA
Total program cost	$842.3	$857.6	1.8
Program unit cost	$842.340	$857.618	1.8
Total quantities	1	1	0.0
Acquisition cycle time (months)	NA	NA	NA

The SBSS program initiated development with none of its five critical technologies mature, although all of the technologies have now been tested in a relevant environment. The SBSS design appears stable and 100 percent of the design drawings have been released to manufacturing. Production maturity could not be assessed because the contractor does not collect statistical process control data. In 2005, the program experienced cost growth with payload electronics, sensor assembly, integration and test, and launch locks. In 2006, the program was restructured. New cost and schedule goals were established and a new strategy was designed to reduce assembly, integration and test risk, and relax payload requirements. The SBSS satellite is expected to complete thermal vacuum testing in February 2009 and launch in April 2009, nearly 2 years later than originally planned.

Attainment of Product Knowledge



SBSS Block 10 Program

Technology Maturity

According to the program office, all five critical technologies are mature and have been demonstrated in a relevant environment. The SBSS program began development in late 2003 with none of its five critical technologies mature. The satellite is scheduled to complete thermal vacuum testing in February 2009.

Design Maturity

The SBSS design appears stable. Program officials reported that 100 percent of the space vehicle design drawings have been released to manufacturing. The number of drawings has remained stable since the program's 2006 critical design review. At that point about 74 percent of the total drawings were releasable.

Production Maturity

Production maturity could not be assessed because the program office does not collect statistical process control data. Assembly of the integrated space vehicle, comprising the bus and payload, is complete and in the final stages of integration and test. According to program officials, with the satellite in thermal vacuum testing, no needed rework has been identified. The most recent Defense Contract Management Agency data indicate that the program will incur a cost overrun at program completion of about $37 million.

Other Program Issues

The SBSS program was restructured in 2006 after an independent review team found that the program's original cost and schedule baseline was not executable; the assembly, integration, and test plan was risky; and the requirements were overstated. The program's largest cost driver was in payload development; specifically, problems with the sensor and electronics. The restructure provided for increased funding and schedule margin; streamlined the assembly, integration, and test plan; and relaxed requirements.

Satellite and launch vehicle compatibility tests have yet to be completed even though this will be the first launch for the Minotaur IV launch vehicle. Although satellite and launch vehicle compatibility has been verified through testing, there are some interface requirements still being resolved between the Minotaur launch vehicle and SBSS satellite. According to the Minotaur IV user's guide, integration events should occur about 6 months before a planned launch. According to program officials, the satellite is scheduled for launch in April 2009. However, the current baseline shows that the SBSS satellite will be available for launch in June 2009.

Program officials have not made a decision to purchase additional Block 10 satellites or enhanced SBSS satellites. Parts obsolescence could be an issue in this decision. However, according to program officials, these parts could be transitioned as spares to support a second build of a Block 10 satelllite, if the decision is made to do so.

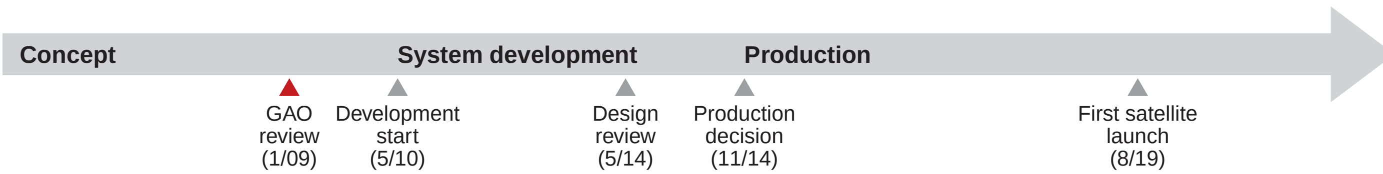
Program Office Comments

In January 2008, the program office estimate for the total system cost was $826 million (in then-year dollars). As of September 2008, this estimate remains the same. Unit cost for SBSS Block 10 includes development of the satellite and ground system, acquisition of and integration with the launch vehicle, program office technical support and oversight, and operations and sustainment of the system through completion of initial operational test and evaluation.

Transformational Satellite Communications System (TSAT)

The Air Force's TSAT system will provide high-data-rate military satellite communications services to DOD users worldwide, including mobile tactical warfighting elements. The system will provide survivable, jam-resistant, global, secure, and general-purpose radio frequency cross-links with other air and space systems. The TSAT system will consist of a constellation of four satellites, plus a spare, a network management architecture, and a ground control system. We assessed the satellites and the ground system.

Source: TSAT Program Office.



Program Essentials

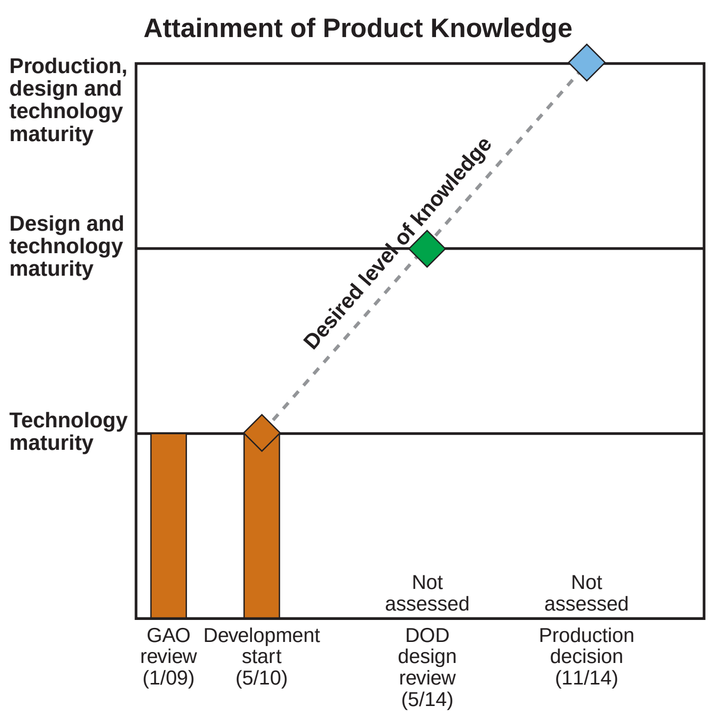
Prime contractor: SE&I: Booz Allen Hamilton, TMOS: Lockheed Martin Integrated Systems Solutions
Program office: El Segundo, CA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2009 dollars in millions)

	As of 05/2010	Latest 08/2008	Percent change
Research and development cost	NA	$7,541.0	NA
Procurement cost	NA	$198.9	NA
Total program cost	NA	$7,801.9	NA
Program unit cost	NA	$1,560.380	NA
Total quantities	NA	5	NA
Acquisition cycle time (months)	NA	TBD	NA

Columns include costs and quantities budgeted for fiscal years 2007 to 2013.

According to the program office, all seven critical technologies are mature. In July 2008, an independent technology readiness assessment revalidated the maturity of the critical technologies. Design stability and production maturity could not be assessed because the development phase has not yet begun. A Defense Space Acquisition Board is scheduled to convene in late 2009 to determine if the overall TSAT program is ready to enter the development phase. The first planned satellite launch is now scheduled for no later than 2019—almost 4 years later than previously reported.



TSAT Program

Technology Maturity

According to the Air Force, the independent technology readiness assessment determined that all TSAT critical technology elements are at a technology readiness level of at least a six, which is the appropriate level of maturity for the program to move into the next phase. The extended Risk Reduction and System Definition contracts will continue to develop the program while ensuring a stable industrial base for the award of the development and production phase contract.

Other Program Issues

Information on cost, design stability, production maturity, or satellite software development metrics will not be available until the TSAT program formally enters the development phase and awards the space segment contract. The Air Force expects to award the space segment contract in 2010. By that time, the program should also have an approved program baseline that includes cost estimates for the first block of satellites and key milestone dates. These events have been delayed since early 2008 to allow time for the Office of the Secretary of Defense (OSD) to assess the results of its study of the military satellite communications investment strategy with the intent of balancing affordability across the military satellite communications portfolio. According to the program office, OSD concluded that the Air Force should continue with the process to award the space segment contract for TSAT. However, the board review did not occur as scheduled, and in late 2008, DOD decided to restructure the program. A new board review date has been scheduled for late 2009.

The TSAT program office now estimates the first satellite launch date to be 2019—almost 4 years later than previously reported. The delay was supported by the Office of the Joint Chiefs of Staff which had concerns about TSAT's development progress and synchronization with other programs.

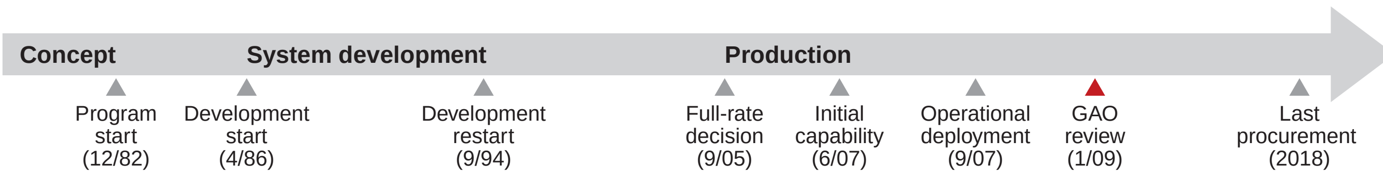
Program Office Comments

In commenting on a draft of this assessment, the Air Force stated that since our last assessment, an OSD-led affordability study resulted in a DOD decision to restructure the TSAT program. The Joint Requirements Oversight Council (JRCOM 2008-08) directed the program office to restructure the TSAT program to satisfy a new capacity key performance parameter and provide a phased approach for capacity growth. According to the Air Force, the Key Decision Point B (KDP-B) Defense Space Acquisition Board will be rescheduled for the first quarter of fiscal year 2010 (October-December 2009) to support the fiscal year 2010 contract award.

V-22 Joint Services Advanced Vertical Lift Aircraft

The V-22 is a tilt-rotor aircraft developed for Marine Corps, Air Force, and Navy use. The MV-22 will replace Marine Corps CH-46E helicopters. The MV-22 Block B variant addresses reliability and maintenance concerns of earlier variants. It has been deployed in Iraq since September 2007, and a shipboard deployment is set for 2009. The Air Force Special Operations Forces CV-22 variant was deployed to Africa in 2008. Our assessment focuses on the MV-22 Block B but applies to the CV-22 as they have common design and manufacturing processes.

Source: U.S. Marine Corps.



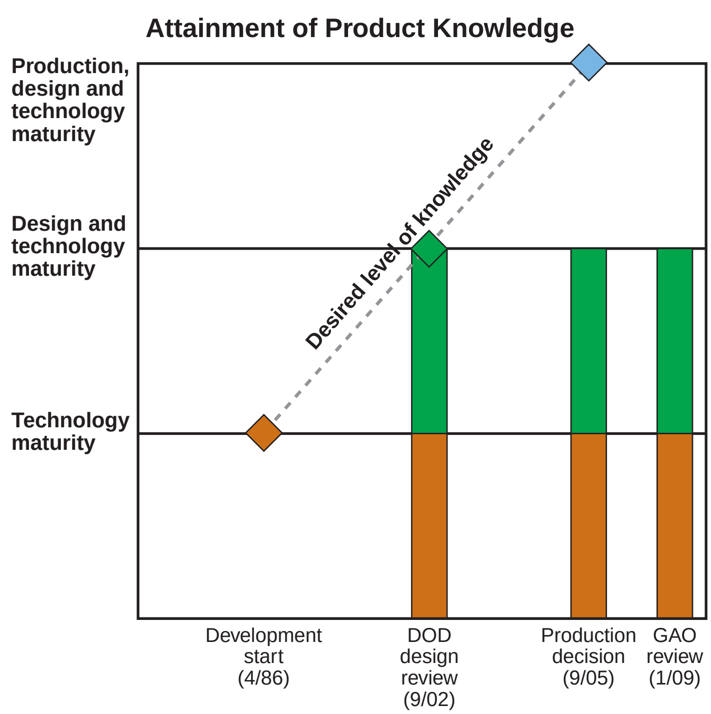
Program Essentials

Prime contractor: Bell-Boeing JPO
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $415.3 million
- Procurement: $24,863.4 million
- Total funding: $25,419.9 million
- Procurement quantity: 318

Program Performance (fiscal year 2009 dollars in millions)

	As of 04/1986	Latest 12/2007	Percent change
Research and development cost	$4,095.4	$12,664.5	209.2
Procurement cost	$34,401.7	$42,603.5	23.8
Total program cost	$38,725.7	$55,544.0	43.4
Program unit cost	$42.416	$121.275	185.9
Total quantities	913	458	-49.8
Acquisition cycle time (months)	117	294	151.3

The V-22 has been deployed in Iraq for over a year. While the V-22's mission capability and full-mission capability rates were short of its goals, the Marine Corps considers the deployment a success, and the aircraft's speed and range were demonstrated in transporting troops and internal cargo. The V-22 was rarely tasked with external cargo lift operations. The deployment also highlighted reliability and service-life issues with certain components and the engines. In addition, the program is adding technologies to improve the system's utility. In March 2008, the Marine Corps signed a 5-year contract for 167 aircraft; however, the demand for spare parts for deployed aircraft and the acceleration of CV-22 production could both pose challenges for ramping up MV-22 production.



V-22 Program

Technology Maturity and Design Stability

The V-22 is being procured in blocks. The program office considers the MV-22 critical technologies to be mature and its design stable. However, MV-22 Block B aircraft, the full-rate production configuration deployed to Iraq, have experienced reliability problems. These aircraft fell short of their mission capability goal (the ability to accomplish any one mission), due in part to component reliability problems with parts such as gearboxes and generators. The aircraft fell well short of its full-mission capability goal (the ability to accomplish all missions), primarily due to a complex and unreliable de-icing system. During the Iraq deployment, the V-22's less than 400 hour engine service life fell short of the 500-600 hours estimated by program management. The program office noted that the contract does not require a specific service life to be met. Also, pending modifications to the program's engine support contract with Rolls Royce could result in increased support costs in the future.

Planned upgrades to the aircraft could affect the aircraft's ability to meet its requirements. A limited-coverage, ramp-mounted defensive weapon was installed on aircraft deployed to Iraq. The program plans to incorporate a mission-configurable, belly-mounted defensive weapon system that will provide fuller coverage. For missions requiring the new weapon, however, the interior space needed to integrate the system will reduce the V-22's troop carrying capability below its key performance parameter of 24 troops, as well as reduce its internal cargo capacity. The program also plans to integrate an all-weather radar into the V-22. This radar and an effective de-icing system are essential for self-deploying the V-22 without a radar-capable escort and deploying the V-22 to areas such as Afghanistan, where icing conditions are more likely to be encountered. However, expected weight increases from these and other upgrades, as well as general weight increases for heavier individual body armor and equipment may affect the V-22's ability to maintain key performance parameters, such as speed, range, and troop carrying capacity.

While the program office reports a stable design, changes can be expected in order to to integrate planned upgrades. Issues with the aircraft's internal cargo handling capability were identified during Iraq operations and led to significant delays. Program officials state that revised techniques and procedures reduced these delays. External cargo carriage missions were rarely assigned to V-22s in Iraq, as mission tasking during this period required minimal external lift support. In addition, most external loads cannot be carried at speeds that leverage the high-speed capability of the V-22. The program is adding forward firing countermeasures to enhance the aircraft's survivability; modifying the engine air particle separator to prevent engine fires and enhance system reliability; and improving the environmental control system.

The Navy and Marine Corps conducted training for the V-22's shipboard deployment and identified challenges related to this operating environment. Design changes are already being made to some of the ships on which the V-22 will deploy to help ensure effective operations on the flight deck and in the hangar deck during maintenance. The changes will also provide increased space for V-22 spare parts.

Production Maturity

In March 2008, the V-22 program signed a $10.4 billion multiyear production contract with Bell Boeing for the production of 167 aircraft through 2012, even though aircraft continue to be conditionally accepted with deviations and waivers relating to components such as brakes, landing gear, hydraulic hoses, de-icing systems, and radar altimeters. The demand for spare parts for deployed aircraft and the acceleration of CV-22 production could both pose challenges for ramping up V-22 production from 11 in 2005 to 36 in 2009. For example, lessons learned from the initial Iraq deployment stated that the lead time for and lack of availability of MV-22 repair parts led to high cannibalization rates.

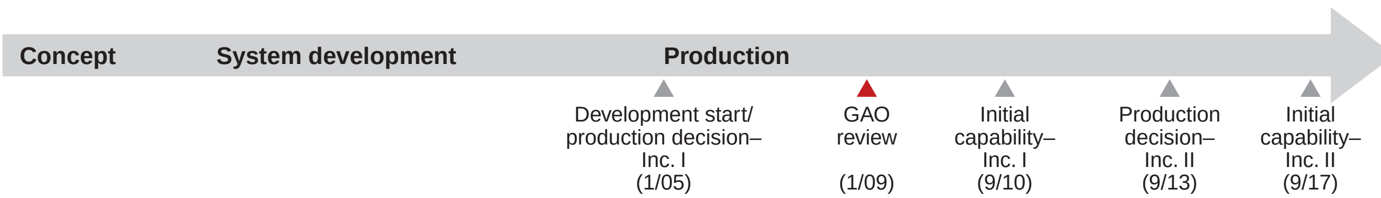
Program Office Comments

In commenting on a draft of this assessment, the V-22 program office provided technical comments, which were incorporated where appropriate.

VH-71 Presidential Helicopter Replacement Program

The Navy's VH-71 will be a dual-piloted, multi-engine helicopter employed by Marine Helicopter Squadron One to provide safe, reliable, and timely transportation for the President and Vice President of the United States, heads of state, and others. When the President is aboard, it will serve as the Commander in Chief's primary command and control platform. The VH-71 will replace the VH-3D and VH-60N, and is planned to be developed in two increments. We assessed Increment I and made observations on Increment II.

Source: AgustaWestland.



Program Essentials

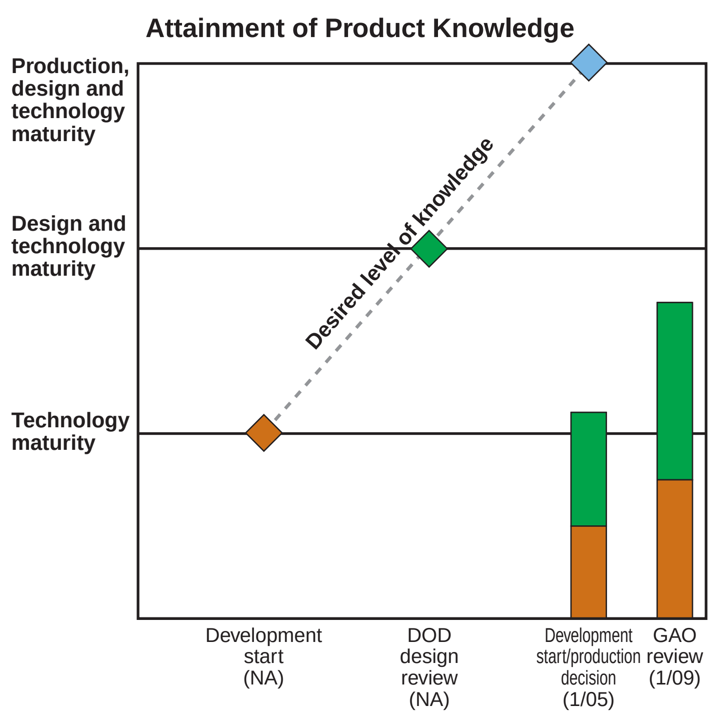
Prime contractor: Lockheed Martin Systems Integration
Program office: Patuxent River, MD
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2009 dollars in millions)

	As of 02/2006	Latest 12/2007	Percent change
Research and development cost	$3,890.3	TBD	NA
Procurement cost	$2,450.2	TBD	NA
Total program cost	$6,523.9	TBD	NA
Program unit cost	$283.647	TBD	NA
Total quantities	23	TBD	NA
Acquisition cycle time (months)	57	TBD	NA

Current cost estimates are unknown until the the program completes its restructuring process.

The VH-71 program began system development and committed to production without achieving design stability or demonstrating production maturity due to a high-risk schedule driven by White House needs. The program now faces a critical Nunn-McCurdy breach due to continued cost increases. The program is near full technology maturity and design stability for Increment I. However, concurrency in design, production, and testing continues to put Increment I at risk for further cost growth and schedule delays. The program office presently expects initial operating capability for Increment I in 2010 or later. Increment II is being restructured, and the VH-71 program office recently requested a proposal from Lockheed Martin to modify its existing contract to reflect the restructured program. Costs for the restructured program could grow to over $11 billion.



VH-71 Program

Technology Maturity and Design Maturity

Increment I of the VH-71 program is nearing technology maturity and design stability. A January 2004 Technology Readiness Assessment concluded that there are no critical technologies on the program. One of the two critical technologies originally identified by the program—the Communication and Subsystem Processing Embedded Resource Communication Controller—has been tested in a laboratory setting, but not demonstrated in a realistic environment. As of May 2008, about 90 percent of expected Increment I engineering drawings were released.

For Increment II, no critical technologies have been identified. Program officials estimate roughly 50 percent of the Increment I and II designs will be common. The most significant differences will be a new engine, transmission, and main rotor blade. The Increment II blade will be larger than Increment I, and will employ a new design, which has been implemented on another aircraft but must be scaled up by 30 percent.

Production Maturity

Increment I production is underway, but concurrent design, production, and testing continues to drive program risk. Although VH-71 officials have identified metrics to evaluate production, they said that they have not been able to set specific targets for these measures because of continued design iterations. Program officials reported some quality concerns with the initial aircraft, including foreign object debris, but DCMA officials noted that these issues are of concern only because of the rigorous standards of a presidential aircraft, and would not otherwise be seen as problems. The program office is flight testing two Increment I aircraft. Delivery of the first missionized test article is expected in April 2009, which will allow testing of the aircraft's integrated systems.

Other Program Issues

The VH-71 program began with a compressed schedule dictated by White House needs stemming from the September 11, 2001, terrorist attacks. According to the program manager, this aggressive acquisition strategy included a source selection process that was shorter than desired and contributed to confusion regarding specifications between the program office and the contractor and concurrent design, testing, and production that resulted in increased program risk, an unsustainable schedule, and inaccurate cost estimates. As a result of continued cost growth, program officials expect to initiate the certification process for a critical Nunn-McCurdy breach in January 2009.

Increment II is being restructured and the VH-71 program office recently requested a proposal from Lockheed Martin to modify its existing contract to reflect the restructured program. The program faces significant challenges due to funding instability. Fiscal year 2008 budget reductions slowed program progress, and a stop work order has been in place for Increment II since December 2007. In addition, the joint statement accompanying the 2009 Defense Appropriation Act recommended $212 million less funding than requested for Increment II. According to program officials, this will prevent any Increment II work during fiscal year 2009 and result in a further 18-month delay in Increment II initial operating capability beyond the fiscal year 2017 date anticipated in the proposed restructured schedule. Officials also said the shortfall would cause about $640 million in cost growth above the $11.2 billion estimated total program cost.

Increment I aircraft will have a short service life of 1,500 hours compared to the 10,000-hour service life of Increment II aircraft. The program manager estimated that remedies to extend use of Increment I aircraft would take about 4 years to implement, making this approach of limited use to address delays in Increment II availability. According to program officials, the short service life is in part because Increment I lacks some redundant fail-safe design elements. Program officials have requested funding for a fatigue test article, but they stated that it would take 2 years to assess fatigue problems and another 2 years to develop remedies.

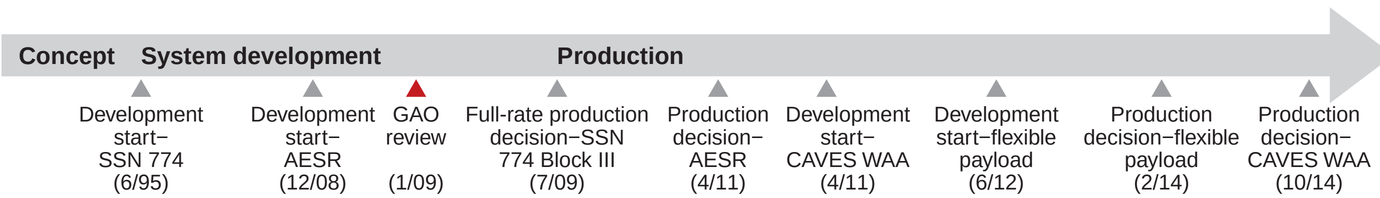
Program Office Comments

In commenting on a draft of this assessment, the Navy stated that the program is executing an accelerated schedule driven by an urgent need to replace existing aging assets. Concurrency in development, design, and production was necessary to meet the accelerated schedule, but Increment II will follow a more typical acquisition approach. The Navy reported that significant production maturity has been demonstrated for Increment I, including the first flights of two pilot production aircraft.

Virginia Class Submarine (SSN 774)

The Navy's Virginia-class attack submarine is designed to combat enemy submarines and surface ships, fire cruise missiles, and provide improved surveillance and special operation support to enhance littoral warfare. The Navy is gradually introducing three new technologies to improve performance and lower construction costs. The Navy is also working towards a goal of reducing construction costs by approximately $400 million per ship by fiscal year 2012. We assessed the status of the three new technologies and the cost reduction effort.

Source: U.S. Navy.



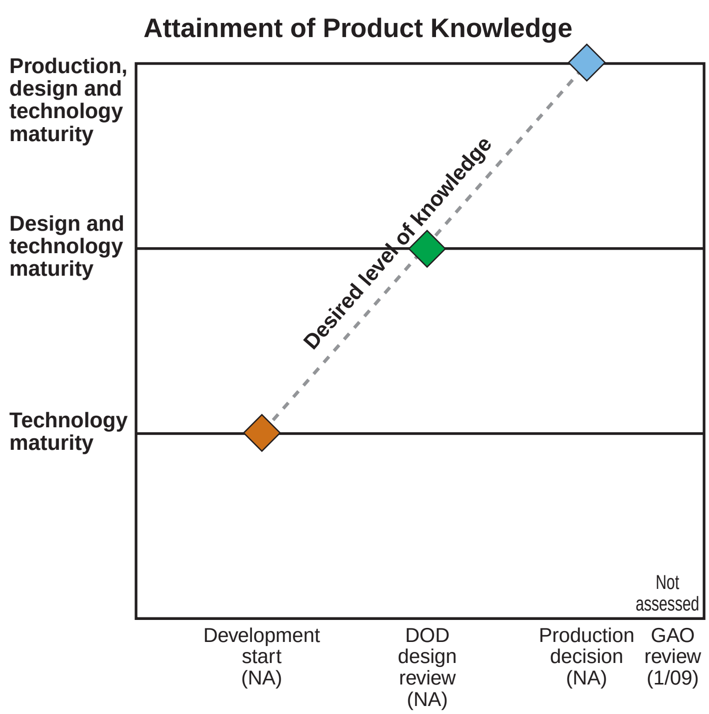
Program Essentials

Prime contractor: General Dynamics, Electric Boat Corporation
Program office: Washington, DC
Funding needed to complete:
- R&D: $1,026.4 million
- Procurement: $46,119.0 million
- Total funding: $47,145.4 million
- Procurement quantity: 20

Program Performance (fiscal year 2009 dollars in millions)

	As of 06/1995	Latest 12/2007	Percent change
Research and development cost	$4,349.8	$6,233.8	43.3
Procurement cost	$54,027.8	$75,322.4	39.4
Total program cost	$58,377.5	$81,556.2	39.7
Program unit cost	$1,945.918	$2,718.540	39.7
Total quantities	30	30	0.0
Acquisition cycle time (months)	134	151	12.7

The Navy is gradually introducing three new technologies—advanced electromagnetic signature reduction, a flexible payload sail, and a conformal acoustic velocity sensor wide aperture array—on new or existing submarines as they mature. The Navy has also focused on reducing the cost per submarine from $2.4 billion to $2.0 billion (in 2005 dollars, or $2.2 in 2009 dollars), and seems to be on track to achieve this goal. The Navy has invested $600 million in this cost reduction effort and, according to Navy officials, reduced costs by more than $172 million per ship through design changes and construction time reductions. Many of the design changes will be implemented beginning with the first ship of Block III currently scheduled for fiscal 2009. Navy officials stated plans to order two submarines a year in 2011 to further reduce costs.



Virginia Class Submarine Program

Technology Maturity

There are three new technologies that the Navy plans to incorporate on current and future Virginia Class submarines once they mature. Advanced electromagnetic signature reduction is a software package comprised of two systems that use improved algorithms to continuously monitor and recalibrate the submarine's signature. The basic algorithms required to support this technology have been proven on other submarines, and Navy officials stated they are now developing software and conducting laboratory tests in support of algorithm development. Navy officials stated they expect the technology to be installed during new construction starting with SSN 781 and back-fit during modernization for earlier ships.

The flexible payload sail (formerly the advanced sail)—a redesign of the structure that sits atop the main body of the submarine—will allow the sail to house additional systems and payloads. According to Navy officials, the flexible payload sail design replaced the advanced sail due to concerns about weight, hydrodynamic performance, and access to the weapons trunk. The design of the flexible payload is under review for inclusion on later submarines.

The conformal acoustic velocity sensor wide aperture array is intended to be a more cost-effective sensor array that replaces transducers with accelerometers, while providing the same capability. According to the Navy, the new array is expected to save $11 milliion to $12 million per submarine, and consists of panels that will be integrated with one of two types of sensors designed to detect vibrations and acoustic signatures of targets—ceramic accelerometers, a mature but more costly technology, or fiber-optic accelerometers, a less expensive but immature technology. According to program officials, testing of panels incorporating both types of sensors was completed in December 2008, and a decision on which accelerometer will be selected is expected by the end of fiscal year 2009, and at-sea testing is expected in 2010.

Other Program Issues

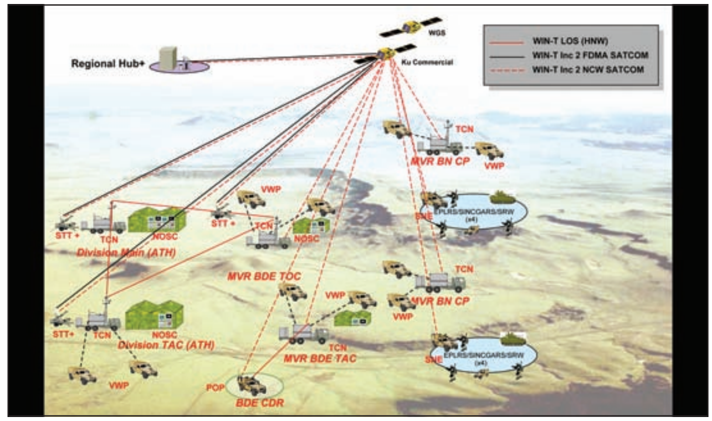
Navy officials stated that they are currently conducting an operational evaluation of the Virginia class, and in July 2009 hope to conduct a milestone review to assess the health of the program. One of the program's near-term focuses is to reduce the cost of each submarine by $400 million (in 2005 dollars) by 2012. Thus far, the Navy has realized cost reductions of $84.2 million through design changes. For example, the bow of the submarine has been redesigned to replace the spherical sonar array with a hull conforming sonar array, which program officials say is easier and cheaper to build. Program officials also stated that the twelve vertical launch tubes will be replaced with two large payload tubes, similar to those on guided missile submarines, to simplify construction. The Navy realized an additional $87.9 million in cost reductions by decreasing construction time from 95 to 66 months. Program officials attributed the decrease to the shipyards gaining familiarity with building the ship, and the integration of more efficient building processes, such as coating the submarine hulls at a more efficient stage in the process. This change alone allows the shipyard to save up to 6 months in construction. Program officials told us the Block III contract, signed in December 2008, includes the design change and schedule reduction savings described above, an expected $200 million in savings due to escalating production and beginning multi-year procurement, and a further $28 million in reductions gained through contract negotiations.

Program Office Comments

The program office provided technical comments on a draft of this assessment, which were incorporated as appropriate.

Warfighter Information Network-Tactical, Increment 2

WIN-T is the Army's high-speed and high-capacity backbone communications network. WIN-T connects Army units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a Nunn-McCurdy unit cost breach of the critical threshold, and will be fielded in four increments. The second increment will provide the Army with an initial networking on-the-move capability.



Source: Office of the Project Manager WIN-T.

Concept | **System development** | **Production**

- Program/ development start (6/07)
- Design review (2/08)
- GAO review (1/09)
- Low-rate decision (6/09)
- Full-rate decision (3/11)
- Initial capability (2/12)

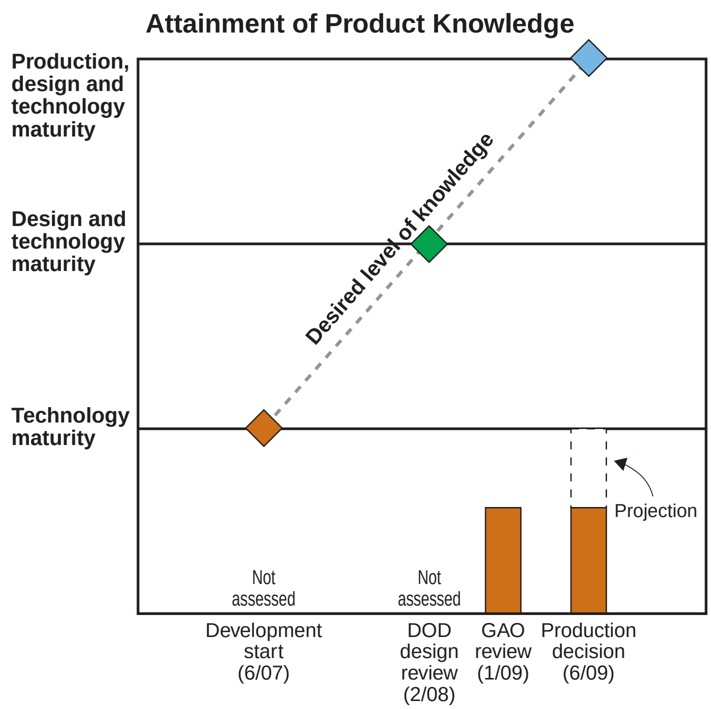
Program Essentials

Prime contractor: General Dynamics C4 Systems Corp.
Program office: Ft. Monmouth, NJ
Funding needed to complete:
R&D: $111.1 million
Procurement: $3,351.1 million
Total funding: $3,462.2 million
Procurement quantity: 1,837

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2007	Latest 09/2008	Percent change
Research and development cost	$230.4	$230.4	0.0
Procurement cost	$3,351.1	$3,351.1	0.0
Total program cost	$3,581.5	$3,581.5	0.0
Program unit cost	$1.892	$1.892	0.0
Total quantities	1,893	1,893	0.0
Acquisition cycle time (months)	50	56	12.0

Fourteen of the WIN-T Increment 2's 15 critical technologies are mature or approaching maturity. The Office of the Secretary of Defense's Director of Defense Research and Engineering (DDR&E) has raised concerns about the maturity of the remaining critical technology, which enables network quality of service. When the WIN-T Increment 2 began development in June 2007, 7 critical technologies were mature or approaching maturity; however the other 8 could not be assessed because the Army did not provide sufficient evidence on their maturity to DDR&E. Similarly, even though the WIN-T Increment 2 program held a critical design review in February 2008, we could not assess design stability because the program office does not track the number of releasable drawings. According to the program office, this metric is not meaningful because WIN-T is not a manufacturing effort.



WIN-T Inc 2 Program

Technology Maturity

Three of WIN-T Increment 2's 15 critical technologies are mature, while 11 others are approaching maturity. The maturity of the remaining technology is unclear. In March 2008, the Office of the Secretary of Defense's Director of Defense Research and Engineering (DDR&E) approved WIN-T Increment 2's technology readiness assessment, and confirmed that 14 of its 15 critical technologies are either mature or approaching maturity. However, DDR&E raised concerns with the maturity of the 15th critical technology, which enables network quality of service by controlling the admission of data onto the network based on the priority of the data and local network conditions. DDR&E has requested that the Army provide additional evidence demonstrating the maturity of this critical technology. In October 2008, the Army provided DDR&E with additional evidence based on laboratory demonstrations carried out by the WIN-T contractor. Moreover, the Army conducted additional WIN-T Increment 2 field testing in November and December 2008. While DDR&E believes that this additional evidence and the results from field testing will be sufficient to establish the maturity of this critical technology, officials do not expect to confirm a maturity rating until the results of field testing have been fully analyzed, and until the Army has completed a technology readiness assessment for WIN-T Increment 3 and submitted it to DDR&E for review; the Army plans to complete this technology readiness assessment by March 2009. Program officials estimate that all 15 critical technologies will be mature by the start of production in June 2009.

The original WIN-T program entered system development in August 2003 with only 3 of its 12 critical technologies approaching maturity, and none were fully mature. Insufficient technical readiness was cited as one of the key factors leading to the March 2007 Nunn-McCurdy unit cost breach of the original WIN-T program. Following that cost breach, the WIN-T program was restructured to be fielded incrementally using more mature technologies. However, the maturity of WIN-T Increment 2's 15 critical technologies could not be assessed when development began in June 2007 because insufficient evidence had been provided to DDR&E to support technology maturity ratings for 8 of the critical technologies. The other 7 technologies were mature or approaching maturity.

Design Maturity

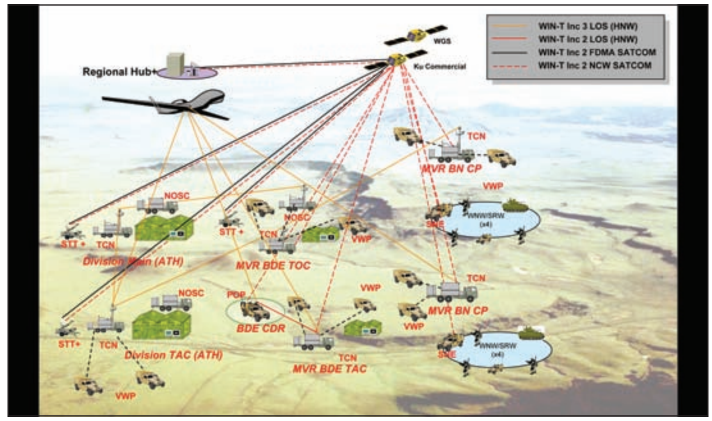
According to program officials, WIN-T Increment 2 completed a successful critical design review in February 2008; however, we could not assess the design stability of the WIN-T Increment 2 because the program office does not track the number of releasable drawings. According to the program office, this metric is not meaningful because WIN-T is not a manufacturing effort. Instead it measures performance through a series of component, subsystem, configuration item, and network level test events designed to demonstrate performance at increasing levels of system integration.

Program Office Comments

In commenting on a draft of this assessment, the Army noted that the WIN-T Increment 2 program office had completed its developmental test in November 2008. This test was a technical test designed to verify and validate the systems engineering process and prove that the system design is on track to satisfy the required technical capabilities. The test was conducted at Ft. Huachuca, Arizona and included the Increment 2 equipment needed to support an Army brigade combat team and key elements of an Army division. The test also included a representative suite of WIN-T Increment 1 equipment to demonstrate interoperability across the increments. The Army noted that while data from the test is still being analyzed, it believes that preliminary analysis has provided the WIN-T program office with confidence that the Increment 2 design is stable and meets the required performance capability. Moreover, the Army believes that results from this test will demonstrate that all Increment 2 critical technologies are mature. The program office is currently preparing for a limited user test to be conducted in March 2009 to demonstrate that WIN-T Increment 2 will meet its operational requirements.

Warfighter Information Network-Tactical Increment 3

WIN-T is the Army's high-speed and high-capacity backbone communications network. WIN-T connects Army units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a Nunn-McCurdy unit cost breach of the critical threshold, and will be fielded in four increments. The third increment will provide the Army a full networking on-the-move capability and fully support the Army's Future Combat Systems.



Source: Office of the Project Manager WIN-T.

Concept | System development | Production

- Program/ development start (7/03)
- GAO review (1/09)
- Design review (11/09)
- Low-rate decision (3/12)
- Full-rate decision (9/15)
- Initial capability (2/16)

Program Essentials

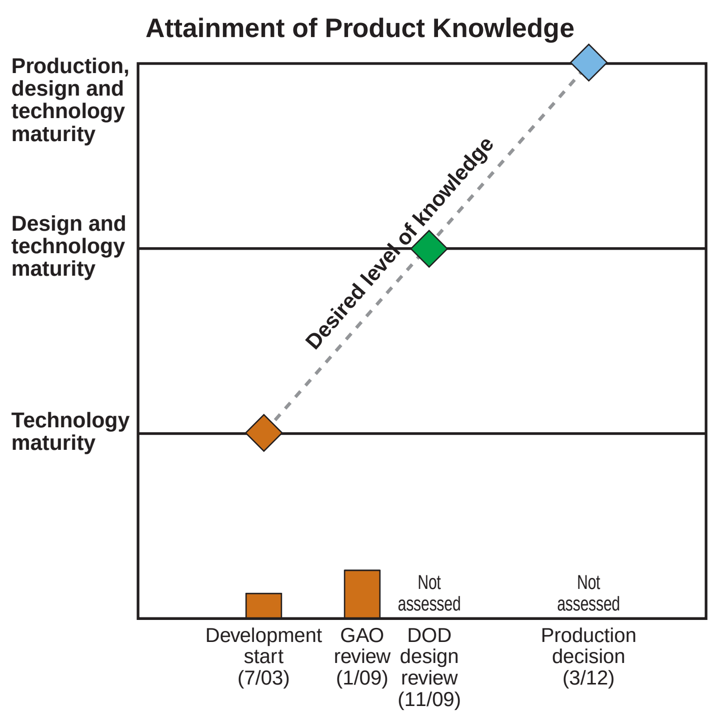
Prime contractor: General Dynamics C4 Systems Corp.
Program office: Ft. Monmouth, NJ
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2009 dollars in millions)

	As of 10/2007	Latest 09/2008	Percent change
Research and development cost	NA	NA	NA
Procurement cost	NA	NA	NA
Total program cost	NA	NA	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Costs and quantities for Increment 3 are not available from the Army due to the absence of an approved acquisition program baseline.

The Army concluded that 11 out of the WIN-T Increment 3's 19 critical technologies were mature or approaching maturity at its second preliminary design review in September 2008. Since the WIN-T program was restructured in June 2007, the maturity of the other 8 technologies has not been assessed. However, the Office of the Secretary of Defense has questioned whether 12 of the 19 technologies are approaching maturity since September 2006. The Army must complete a technology readiness assessment of WIN-T Increment 3 and get DDR&E concurrence that all critical technologies are approaching maturity before an acquisition program baseline for the program can be approved. Army officials expect to have an approved baseline by June 2009 at which point a cost estimate for the program will also be available.



WIN-T Inc 3 Program

Technology Maturity

According to the Army, three of the WIN-T Increment 3's 19 critical technologies are mature and 8 are approaching maturity. Since the WIN-T program was restructured in June 2007, the remaining 8 technologies have not been assessed and the program was unable to provide evidence of their current level of maturity. The Office of the Secretary of Defense's Director of Defense Research and Engineering (DDR&E) has questioned whether twelve technologies are approaching maturity since September 2006, including four of the eight technologies that the Army assessed as approaching maturity. The program has developed technology maturation plans, which included conducting a key 30-node test in November 2008. The results of this test are intended to demonstrate the maturity level of most WIN-T critical technologies. Army officials also noted that they plan to complete a technology readiness assessment of WIN-T Increment 3 by March 2009. DDR&E will review this assessment. DDR&E must assess the technologies of WIN-T Increment 3 as approaching maturity before an acquisition program baseline can be approved and as fully mature prior to the start of the increment's production.

The original WIN-T program entered system development in July 2003 with only 3 of its 12 critical technologies approaching full maturity, and none were fully mature. Insufficient technical readiness was cited as one of the key factors leading to the June 2007 Nunn-McCurdy unit cost breach of the original WIN-T program. Following that cost breach, the WIN-T program was restructured to be fielded incrementally using more mature technologies.

Design Maturity

We could not assess the design stability of the WIN-T Increment 3 because the program office does not track the number of releasable drawings. According to the program office, this metric is not meaningful because WIN-T is primarily an information system integration effort, not a manufacturing effort. Instead, the program office measures performance through a series of component, subsystem, configuration-item and network-level tests designed to demonstrate increasing levels of system integration. The program plans to conduct its critical design review by summer 2009. Historically, evolving FCS hardware requirements and the immaturity of FCS technologies have affected the requirements for and stability of hardware design for Increment 3 transceivers and antennas mounted in or on FCS vehicles. In October 2008, the Army approved size, weight, power, and cooling requirements for integrating FCS and WIN-T. The full cost to the WIN-T program of meeting these requirements will not be known until DOD approves an Increment 3 acquisition program baseline—expected by June 2009. Future FCS requirements or design changes could further affect WIN-T Increment 3.

Other Program Issues

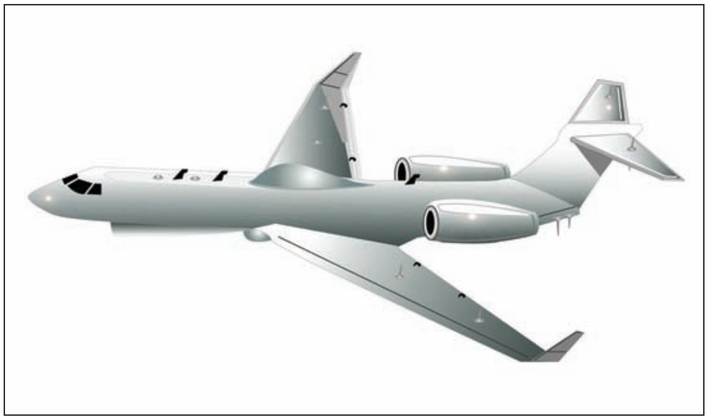
In the defense authorization act for fiscal year 2009, Congress restricted Increment 3's research, development, test, and evaluation funding. No more than 50 percent of this funding can be obligated or expended until DOD notifies Congress of the completion of the following: an acquisition program baseline approved by the Under Secretary of Defense, Acquisition, Technology and Logistics; an independent cost estimate by the DOD Cost Analysis Improvement Group; and a technology readiness assessment by DDR&E.

Program Office Comments

Technical comments provided by the program office were incorporated as appropriate. In addition, on the basis of Army preliminary analysis of the 30-node test, the program office is confident that Increment 3 technologies are mature and scalable to meet the full network on-the-move capability for the Army. Additionally, program officials consider Increment 3 to be on track to address FCS network requirements.

Aerial Common Sensor (ACS)

The Army's ACS is an airborne intelligence, surveillance, reconnaissance (ISR) and target acquisition system intended to provide timely intelligence data on threat forces to the land component commander. It is expected to replace the Army's Guardrail and Airborne Reconnaissance Low systems. The Army is currently assessing requirements for the program and plans to use an incremental approach to deliver an initial set of signals intelligence and imagery intelligence capabilities, followed by greater capabilities in later increments.



Source: Graphic artist rendering of generic ISR Platform. No photo image available.

Current Status

The Army began ACS systems development in July 2004, and was joined by the Navy in an effort to replace the capabilities of the Army's Guardrail and Airborne Reconnaissance Low systems and the Navy's EP-3. The Army terminated the development contract in January 2006, after the contractor reported that the weight of the mission equipment needed to meet both services' requirements exceeded the structural limits of the aircraft. In January 2008, the Army and Navy received approval from the Joint Requirements Oversight Council to split ACS into two separate programs because the Navy required a longer-range aircraft with a larger crew than the Army.

ACS program officials told us that the Army's technology development strategy for ACS has been structured in accordance with newly signed DOD acquisition guidance to include evaluation of competing prototypes and a preliminary design review before the start of system development. The Army plans to issue a request for proposal for technology development in January 2009 and award two technology development contracts in July 2009. The program tentatively plans to award the ACS engineering and manufacturing development contract in fiscal year 2011, after obtaining the approval of the ACS program's Milestone Decision Authority.

Program officials expect the 18- to 24-month technology development effort to mitigate risks related to the maturity of critical technologies and airframe integration and add technical rigor to the program. Previously, the ACS technology development program allowed the use of technologies that were nearing maturity and had been demonstrated in relevant environments; however, the new effort will require the demonstration of mature technologies. In addition, the Army is planning to focus technology development on ACS's system-level design. Program officials report that they have also evaluated technical information on similar ISR systems used by other countries and improved the contents of the systems engineering plan.

Funding, Fiscal Years 2009-2013 (FY09 dollars): TBD.

Next Major Program Event: Technology development contract awards, July 2009.

Program Office Comments: Technical comments provided by the program office were incorporated as appropriate.

Armed Reconnaissance Helicopter (ARH)

Until the program was recently terminated, the Army's ARH was expected to provide reconnaissance and security capability for air and ground maneuver teams. The ARH was to combine a modified off-the-shelf airframe with a nondevelopmental item mission-equipment package and would have replaced the Kiowa Warrior helicopter fleet and portions of the Army National Guard's Apache assets. A streamlined acquisition strategy was proposed for the ARH program in order to support current military operations.

Source: ARH Prototype #1 Flight Testing at Bell Helicopter, © 2006 Bell Helicopter, A Textron Company.

Current Status

In October 2008, DOD ended the current ARH program when the Undersecretary of Defense for Acquisition, Technology, and Logistics decided not to certify it for continuation after a critical Nunn-McCurdy unit cost breach. The Army subsequently terminated its prime contract for convenience. In the Army's July 2008 Nunn-McCurdy notification to Congress, it noted at least 25 percent cost growth attributed to an increase in actual labor hours and material costs to complete the development phase and an increase in contractor labor rates higher than previous projections. According to an OSD memorandum on the decision not to continue the program, OSD believed that the fundamental cost and schedule basis underlying the ARH contract was no longer valid. OSD teams also found that there is at least one alternative that will provide equal or better capability at less cost and that the current ARH management structure is inadequate.

The decision to end the current ARH contract will further delay the delivery of a replacement for Kiowa Warrior and National Guard Apache assets, but it will allow for near-term funds to be spent on Kiowa Warrior upgrades in lieu of an operationally viable alternative. During the Nunn-McCurdy process, OSD validated the need for a manned helicopter that is armed, small, and maneuverable. Based on recent feedback from operational theaters, OSD stated that the replacement for the Kiowa Warrior would operate in concert with current Apache and extended-range, multi-purpose unmanned aerial systems and would together be used for attack, reconnaissance, intelligence, surveillance, and target acquisition missions.

Funding Fiscal Years 2009-2013 (FY09 dollars): TBD.

Next Major Program Event: NA.

Program Office Comments: In commenting on a draft of this assessment, the Army provided technical comments which were incorporated as appropriate.

Combat Search and Rescue Replacement Vehicle (CSAR-X)

The Air Force's Combat Search and Rescue Replacement Vehicle (CSAR-X) is planned to provide a vertical take-off and landing aircraft that is quickly deployable and capable of main base and austere location operations for worldwide combat search and rescue and personnel recovery missions. The CSAR-X will be developed in two blocks and will replace the aging HH-60G Pave Hawk helicopter fleet. We assessed Block 0, which is the first block to be developed.

Source: 669 AESS/TH CSAR-X Program Office.
Note: Photo is of the HH-60 Pavehawk, the aircraft the CSAR-X will replace.

Current Status

CSAR-X is being managed as an incremental development program. Block 0 and Block 10 will be managed as separate programs with their own requirements, program baselines, and milestone reviews.

The initiation of CSAR-X Block 0 development has been delayed several times, in part due to two bid protests filed at GAO. The Air Force awarded the Block 0 development contract to Boeing in November 2006, but a bid protest by competing contractors filed with GAO required the Air Force to suspend the beginning of product development activities. In February 2007, GAO sustained the protest. In response, the Air Force amended its request for proposals. However, the competitors filed another bid protest in response to the Air Force's amended request. This second protest was also sustained by GAO in August 2007. As a result, the Air Force has again amended the request for proposals in response to the protest. Further, the Air Force released another amendment in December 2008 to incorporate more changes and clarifications.

Program officials do not expect to award a Block 0 development contract before spring 2009. The delay to Block 0 development will likely affect the entire CSAR-X acquisition schedule including the development of Block 10, which is currently scheduled to start in 2010. Although the Air Force would like to have the first unit of CSAR-X helicopters in the field by 2013, program officials acknowledge that initial operational capability could occur as late as 2015, because of the delays in beginning product development.

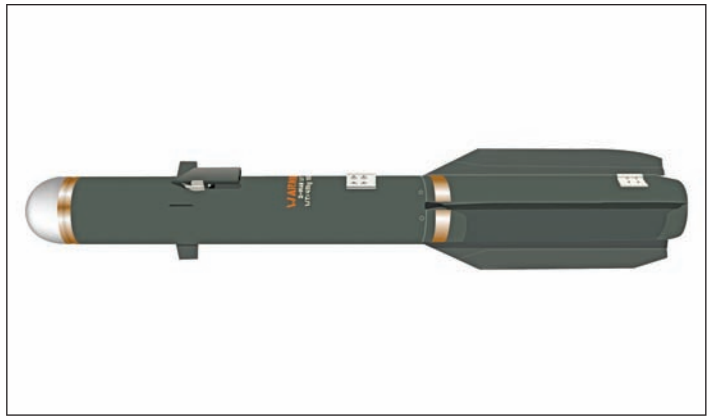
Funding, Fiscal Years 2009-2013 (FY09 dollars): RDT&E $1,764.3 million
Procurement $2,162.0 million

Next Major Program Event: Contract award projected for 2009.

Program Office Comments: The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

Joint Air-to-Ground Missile (JAGM)

JAGM is an Army-led joint program between the Army, Navy, and Marine Corps. The missile will be air-launched from helicopters and fixed- wing aircraft and is designed to target tanks; light armored vehicles; missile launchers; command, control, and communications vehicles; bunkers; and buildings. It is expected to provide line-of-sight and beyond line-of sight capabilities and be employed in a fire-and-forget mode or a precision attack mode. The missile will replace Hellfire, Maverick, and air-launched TOW missiles.



Source: JAMS Project Office.

Current Status

JAGM was approved to start a 27-month technology development phase in September 2008, and the program is implementing DOD's 2007 policy on competitive prototyping. The Army awarded fixed-price incentive contracts to Lockheed Martin and Raytheon for the technology development effort, which will culminate with flight tests of competing Lockheed Martin and Raytheon prototypes. At that time, the Army will down-select to one of the contractors prior to proceeding into system development.

The JAGM program has identified three critical technologies-a multimode seeker for increased countermeasure resistance, boost-sustain propulsion for increased standoff range, and a multipurpose warhead for increased lethality. Program officials noted that many of the components of these technologies are currently in production on other missile systems, but they have not been fully integrated into a single missile. Program officials expect these technologies to be nearing maturity by the start of system development. In addition, the program has identified backup technologies that are almost all mature. However, if these backup technologies are used, they may require additional time and funding to fully integrate them.

The Army will continue to extend Hellfire missiles to meet the needs of the warfighter, while Navy will rely on both Maverick and Hellfire missiles until JAGM becomes available.

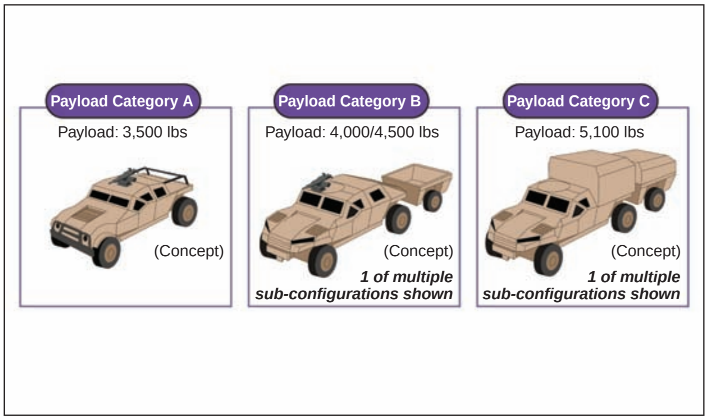
Funding, Fiscal Years 2009-2013: $1,107.9 million

Next Major Program Event: System development start, December 2010.

Program Office Comments: In commenting on a draft of this assessment, the Army concurred with the information provided and provided technical comments, which we incorporated as appropriate.

Joint Light Tactical Vehicle (JLTV)

The Army, U.S. Marine Corps, and Special Operations Command's Joint Light Tactical Vehicle concept is a family of vehicles that is intended to supplement and potentially replace the High-Mobility Multi-Purpose Wheeled Vehicle. The JLTV plans to provide defensive measures covering troops while in transport, increase payload, improve the logistics footprint, and reduce soldier workload associated with system operation and field maintenance activities. JLTV also expects to reduce life cycle costs through commonality at the subassembly and component level.



Source: Joint Combat Support Systems (JCSS) Project Office.

Current Status

JLTV was approved to start a 27-month technology development phase in December 2007. Earlier that year, the program attempted to start system development, but it was directed by the Undersecretary of Defense for Acquisition, Technology, and Logistics to first get approval to enter technology development-an earlier phase of the acquisition cycle. One of the goals of the technology development phase is to demonstrate critical technologies in a relevant environment before proceeding into system development. It is also intended to shorten the length of and reduce the risk associated with system development.

The JLTV program is implementing DOD's 2007 policy on competitive prototyping. The Army plans for 4 of the 10 configurations of JLTV to be prototyped and tested in the technology development phase. In October 2008, the Army awarded three technology development contracts. BAE Systems Land & Armaments, Ground Systems Division was awarded a $73.9 million cost share contract, in which DOD will pay $58.5 million and the contractor will contribute $15.4 million. General Tactical Vehicles, a joint venture between General Dynamics Land Systems and AM General, was awarded a $117 million cost share contract in which both DOD and the contractor will contribute $58.5 million. Lockheed Martin Systems Integration was awarded a $48.9 million cost plus fixed-fee contract. In November 2008, bid protests of the JLTV technology development contract awards were filed with GAO. The Army is in receipt of the protests and has said it will respond in accordance with GAO timelines. GAO will issue its decisions not later than 100 days from the date the protest was filed.

Funding Fiscal Years 2009-2013: $510.3 million (Army—$204.6 million; USMC—$305.7 million)

Next Major Program Event: System Development Start.

Program Office Comments: The Army and Marine Corps provided technical comments, which were incorporated as appropriate.

KC-X

The Air Force KC-X program is the first of three phases in the recapitalization of the current KC-135 aerial refueling tanker fleet. It is planned to provide sustained aerial refueling capability to facilitate global attack, air-bridge, deployment, sustainment, homeland defense, theater support, specialized national defense missions, as well as airlift capabilities for passenger and palletized cargo deployment. The current KC-X acquisition strategy calls for the procurement of 179 commercial aircraft to be modified for military use at an expected cost of about $35 billion

Source: SAF/PAO.

Current Status:

The KC-135 recapitalization is the Air Force's highest acquisition priority and is expected to involve the procurement of about 600 aircraft over 40 years at a cost that could exceed $100 billion. On February 29, 2008, the Air Force selected a consortium consisting of Northrop Grumman and the European Aeronautic Defense and Space Company (EADS)-the parent company of Airbus over Boeing to build the KC-X tankers. In March 2008, Boeing filed a bid protest with GAO. On June 18, 2008, GAO sustained Boeing's protest and, consistent with that decision, recommended that the Air Force reopen discussions with the offerors, obtain revised proposals, re-evaluate the revised proposals, and make a new source selection decision. In July 2008, the Secretary of Defense stated that there would be a new solicitation requesting revised proposals from industry, and the Undersecretary of Defense for Acquisition, Technology and Logistics would replace the Air Force as the source selection authority. DOD expected to award the new contract by December 31, 2008. However, on September 10, 2008, the Secretary announced his decision to terminate the second competition noting there was not enough time for DOD to complete a competition that would be viewed as fair and competitive in such a highly-charged environment by January 2009, when the next administration would take office. He stated that rather than handing the next administration an incomplete and possibly contested process, the next team should review the military requirements objectively and craft a new acquisition strategy. Further, he added that DOD plans to continue funding the program in the fiscal year 2010 through 2015 budget. The Chief of Staff of the Air Force stated that a new KC-X competition could take the new administration between 8 months and 4 years to complete.

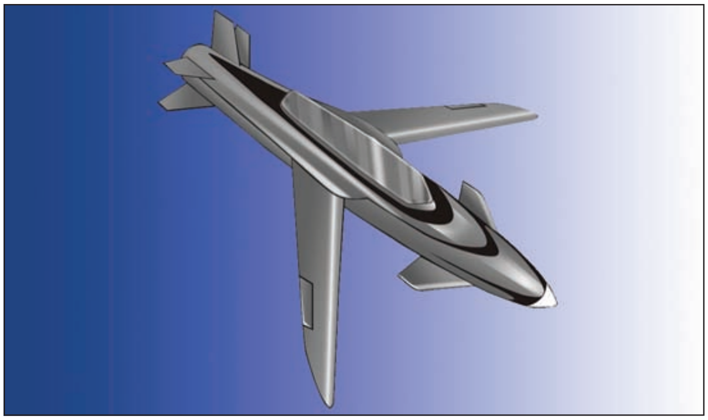
Funding, Fiscal Years 2009-2013 (FY09 dollars): $239.8 million in no-year Tanker Replacement Transfer Funds were rescinded by the Department of Defense Appropriations Act, 2009. However, the accompanying joint explanatory statement tables suggested $23 million in fiscal year 2009 research, development, test and evaluation funds be provided to the program.

Next Major Program Event: Develop new acquisition strategy beginning January 2009.

Program Office Comments: In commenting on a draft of this assessment, DOD concurred with the information provided in the report.

Small Diameter Bomb (SDB), Increment II

The Air Force's Small Diameter Bomb Increment II will provide the capability to attack mobile targets from standoff range in adverse weather. The program builds on a previous increment that provided capability against fixed targets. SDB II will add capability for multiple kills per pass, multiple ordnance carriage, near-precision munitions, and reduced munitions footprint. SDB II will be installed on the Air Force F-15E and the Navy and Marine Corps Joint Strike Fighter, and is designed to work with other aircraft, such as the F-22A.



Source: SDB II Program Office.

Current Status

In May 2006, the SDB II program was approved to start a 42-month technology development phase. One of the goals of the technology development phase is to demonstrate critical technologies in a relevant environment before proceeding into system development. It is also intended to shorten the length of and reduce the risk associated with system development. According to the program office, all five of the SDB II's critical technologies are expected to be approaching maturity by the start of system development in December 2009. The program office reports that two of the SDB II's five critical technologies are currently mature because they are in use on legacy Air Force and Navy systems. Of the three other technologies, the multimode seeker will be the most challenging to demonstrate due to the complexity of the algorithms it requires and size requirements.

For the technology development phase, the Air Force awarded separate risk-reduction contracts to Boeing and Raytheon. The contractors are developing system performance specifications as part of this effort. The contractors will compete for the system development contract, which the program plans to award in December 2009. According to program officials, during system development the contractor will be accountable for system performance, which includes designing the weapon system and planning the developmental test program to verify the system performance.

Funding Fiscal Years 2009-2013 (Fiscal Year 2009 Dollars): $473.547 million

Next Major Program Event: System development start, December 2009.

Program Office Comments: The program office was provided a copy of this draft but did not provide comments.

Agency Comments and Our Evaluation

DOD provided us with written comments on a draft of this report. The comments are reprinted in appendix II. We also received technical comments from DOD, which have been addressed in the report, as appropriate.

Over the past year, we have worked closely with DOD on metrics to measure the performance of DOD's major defense acquisition programs. These discussions have been productive and we have added several new metrics to our portfolio analysis as a result. With regard to the composition of the major defense acquisition program portfolio, DOD believes a better way to measure performance is to track programs that are common to all of the portfolios we examined (2003, 2007, 2008), instead of using portfolios that vary in size and composition. This type of analysis is included in our report. We identified and isolated 58 programs that were part of the 2003 and 2008 major defense acquisition program portfolios and analyzed the estimated cost growth since 2003. The result was consistent with our primary analysis. For these programs, the total funding needed from fiscal year 2004 through their completion increased 27 percent or $179 billion between December 2002 and December 2007. Development funding needs increased 46 percent or $59 billion. In addition, we continue to believe that annual snapshots of the performance of the entire major defense acquisition portfolio are an important indicator of how well DOD's acquisition system generates the return on investment it promises to the warfighter, Congress, and taxpayer. In its comments, DOD mentioned that programs such as the Joint Strike Fighter and Future Combat System will be in the portfolio until 2034 and 2030, respectively, and the $78 billion in cost growth they have experienced will remain in the portfolio as well. Since this $78 billion in cost growth will have to be funded from DOD's investment accounts over that time, including it in our measures of portfolio performance helps to illustrate the lingering opportunity costs of the cost growth from those systems.

DOD also commented that a significant portion of cost growth in the portfolio is attributable to increases in procurement quantities and stated that this does not reflect poor acquisition management. We note that no single number or measurement captures all of the dimensions of cost growth; rather, it is important to look at several measurements to gain insight into the true factors at play. Thus, while it is true that a measurement like total cost growth for a portfolio of weapons does not adjust for increases in quantities that may be unrelated to acquisition management, it is also true that the same measurement does not isolate

offsets to cost growth stemming from quantity reductions, which may, in fact, be symptomatic of acquisition problems. Our analysis shows that quantity reductions far outweigh the added cost of quantity increases. Specifically, while the total cost of the 2008 program portfolio has grown by $48 billion over initial estimates because of quantity increases, quantity decreases amount to $369 billion—a much larger offset against the cumulative cost growth we report.

Lastly, DOD commented that cost growth is the result of many factors, including those unrelated to the acquisition process and the management of programs. While we do not discuss these factors in this report, we could not agree more. For several years, GAO's work has highlighted a number of strategic-level causes that contribute to cost, schedule, and performance problems in DOD's weapon system programs. Specifically, DOD's processes for identifying warfighter needs, allocating resources, and developing and procuring weapon systems, which together define the department's overall weapon system investment strategy, have serious difficulty balancing the competing needs of the services with those of the joint warfighter. The result is a consistent commitment to more programs than resources can support. This imbalance promotes an unhealthy competition for funds. In addition, DOD's funding process does not produce an accurate picture of the department's future resource needs for individual programs—in large part because it allows programs to go forward with unreliable cost estimates and lengthy development cycles. As a result, DOD does not have a sound basis for allocating resources and ensuring program stability. Invariably, DOD and Congress end up continually shifting funds to and from programs—undermining well-performing programs to pay for poorly performing ones. A comprehensive approach that addresses problems in the acquisition process, the requirements process, and funding processes will be needed to improve acquisition outcomes.

We are sending copies of this report to interested congressional committees, the Secretary of Defense, the Secretaries of the Army, Air Force, and Navy, and the Director, Office of Management and Budget. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you have any questions on this report, please contact me at (202) 512-4841. Contact points for our Offices of Congressional Relations and Public

Affairs may be found on the last page of this report. Major contributors to this report are listed in appendix III.

Michael J. Sullivan
Director
Acquisition and Sourcing Management

List of Committees

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Daniel K. Inouye
Chairman
The Honorable Thad Cochran
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United State Senate

The Honorable Ike Skelton
Chairman
The Honorable John M. McHugh
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable John P. Murtha
Chairman
The Honorable C. W. Bill Young
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Scope and Methodology

This report contains analysis of the performance of the Department of Defense (DOD) Major Defense Acquisition Program (MDAP) portfolio for fiscal year 2008 based on data we obtained from the Selected Acquisition Reports (SAR) and other information in the Defense Acquisition Management Information Retrieval Purview system referred to as DAMIR.[1] We retrieved data that showed annual funding requirements for research, development, test, and evaluation (RDT&E) and procurement for 96 major defense acquisition programs with SARs dated December 2007. We converted cost information to fiscal year 2009 dollars using conversion factors from the DOD Comptroller's National Defense Budget Estimates for Fiscal Year 2009 (Table 5-9) and analyzed the data to determine cost growth in RDT&E, procurement, and total acquisition from the first full estimate to the current estimate. We extracted data on quantities and compared current quantities to those initially planned to determine differences in raw quantities and in the Program Acquisition Unit Cost (PAUC). We calculated the number of programs that had experienced a 25 percent cost increase from initial estimates. We also obtained schedule information and calculated cycle time from development start to initial operational capability. Using the SAR data from DAMIR and other GAO reports, we constructed similar analyses for the programs submitting SARs in December 2002 and December 2006 to compare to the data from December 2007. We identified 10 of the most costly programs from the December 2007 SARs and calculated changes in RDT&E and total costs and quantities between the first full estimate and the December 2007 SAR. We excluded DDG 51 and Ballistic Missile Defense System (BMDS) from this analysis, because these programs did not have first estimates or quantity information associated with the SARs. To highlight cost growth in a common set of programs between 2003 and 2008, we determined the common programs and calculated differences in the funding streams for each year. In order to show schedule delays, their magnitude, and the percentage of programs in each category, we calculated cycle time from initial estimates compared to December 2007 data. Through discussions with DOD officials responsible for the database and confirming selected data with program offices, we determined that the SAR data and the information retrieved from DAMIR were sufficiently reliable for our purposes.

[1] DAMIR Purview is an executive information system operated by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics / Acquisition Resources and Analysis.

Data for the total planned investment of major defense acquisition programs was obtained from funding stream data included in the SARs and in DAMIR. We aggregated the data for all programs in three selected portfolios (fiscal years 2003, 2007, and 2008) using fiscal year 2009 dollars. We refer to programs with SARs dated December 2002 as the fiscal year 2003 portfolio; programs with SARs dated December 2006 as the fiscal year 2007 portfolio; and programs with SARs dated December 2007 as the 2008 portfolio. However, the data do not include the full costs of acquiring Missile Defense Agency (MDA) programs, and these programs were not included in our assessment of each portfolio's performance. Further, we divided some SAR programs into smaller elements, because they report performance data separately. We compared cost and schedule data from the first full estimate, generally development start, with the current estimate. For a few programs that did not have a development or full estimate, we compared the current estimate to the planning estimate to measure changes in development costs and schedule delays, but excluded these programs from our analysis of total acquisition costs and PAUC. When comparable cost and schedule data were not available for programs, we excluded them from the analysis. We did not adjust the cost data to reflect changes in quantities that may have occurred over the life of the programs.

Analysis of Selected DOD Programs Using Knowledge-Based Criteria

This section contains assessments of individual weapon programs, and each assessment presents data on the extent to which programs are following a knowledge-based approach to system development. We obtained and analyzed data on knowledge attainment for 47 programs. These programs are all MDAPs—generally between development start and production. We also collected information and provided profiles on 20 additional programs. These programs include

- 8 MDA elements,
- 6 pre–major defense acquisition programs,
- 3 programs in the bid protest process at the time of our review or canceled,
- 1 acquisition category II program, and
- 2 components of MDAPs.

A table listing the systems is found in appendix IV. We selected the programs because of their status as major defense acquisition programs, because of their development cost, or because they are early in development but have high potential of becoming major defense acquisition programs.

To assess the performance and outcomes of the 47 weapon system programs, we collected information contained in the SARs or from program office responses to a questionnaire. To assess the overall outcomes for the 47 programs to date, we identified programs with cost, schedule, and quantity data at the first full estimate, generally Milestone B, and a latest estimate, either a SAR or a program office estimate. Of the programs in our assessment, 44 had relevant data on RDT&E costs; 40 had PAUC data, and 36 had data on schedules for delivering initial quantities. The remaining programs, not included in this analysis, did not have comparable data. We summed the first full estimate and the latest estimate of RDT&E costs for the programs and calculated the percentage change between the two estimates. The unit cost growth assessment reflects the share of the 40 programs that experienced PAUC growth greater than 25 percent. The schedule assessment is the average of the change in months between the first and latest estimates for the planned or actual delivery of initial operational capability.

To assess knowledge attainment of programs at critical decision points, we identified programs that proceeded through each juncture (system development start, DOD design review, and production start) and collected data about their knowledge levels at each point. The data were collected from program offices, as of January 2009, using a questionnaire (additional information on product knowledge is found in the product knowledge assessment section of this appendix). Programs in our assessment were in various stages of the acquisition cycle and not all of the programs provided knowledge information for each point. Programs were not included in our assessments if relevant decision or knowledge point data were not available. For each decision point, we summarize knowledge attainment as the number of programs with data that achieved that knowledge point. The technology maturity for programs at various decision points includes 36 programs at development start, 39 programs at design review, and 40 programs at production, some of which are projected values. We compared the knowledge attainment of programs that entered development from 2006 to 2008 with those that did so from 2004 to 2005, and those that did so from 2002 to 2003, to determine if, over time, programs were reaching this critical juncture with an increasing amount of knowledge. We also assessed

the accumulation of knowledge through the decision points. For development start, we assessed the percentage of programs with mature technologies. For design review, we assessed the number of programs that had stable designs and mature technologies. For production, we assessed the percentage of programs that had production processes in statistical control, a stable design at the critical design review, and mature technologies at development start.

The maturity levels of the 268 critical technologies at development start were collected from program officials as described in further detail in the product knowledge assessment section of this appendix. We only included programs, with their corresponding technologies, that have entered system development. To compare differences in RDT&E cost growth between programs with mature technologies, we examined 36 programs with relevant first and current cost estimates that have passed through development start. We calculated the total RDT&E cost growth for all programs with mature technologies and compared it to total RDT&E cost growth for all programs with technologies that were not fully mature.

To determine the cost growth of systems that conducted technical reviews at appropriate times during the development cycle, we calculated the amount of RDT&E cost growth for systems that held the technical reviews at the appropriate times and compared it to the amount of cost growth for systems that did not hold the technical reviews at the appropriate times. To determine whether there had been an improvement over time in the percent of expected design drawings that were releasable at the time of critical design review, the indicator of stable design, we calculated the average percent of design drawings releasable for the 28 programs with relevant data. We collected data from 33 programs on the date the program conducted or plans to conduct key development tests of a fully configured, integrated, production representative prototype, and compared that data to the program's production decision date. To determine software growth, we collected data on software size from 30 programs and compared the current size to the program's estimate at development start. Using this information, we compared the average percent change in RDT&E cost and delay in delivery of an initial operational capability between programs that had more than a 25 percent increase in lines of codes and those that had less than a 25 percent increase.

We submitted an additional data collection instrument to the 67 programs assessed in this report and obtained programmatic data from 63 of the programs. We did not validate the data provided by the program offices, but

reviewed it and performed various checks. Where we discovered discrepancies, we clarified the data accordingly. Fifty-two of the 63 programs that responded provided data on whether the program had experienced requirements changes after development start. Our analysis includes a comparison of RDT&E cost growth for those programs that experienced requirements changes and those that did not. We did not evaluate the complexity of the requirements changes. We also obtained data from programs on the use of cost estimates from the Cost Analysis Improvement Group or the service and program office staffing.

We obtained the revised DOD 5000.02 Acquisition Instruction from the Office of the Under Secretary of Defense (Acquisition, Technology and Logistics) and compared the revisions to the May 2003 revision. We analyzed the instruction to compare the extent to which the 2008 policies for conducting acquisition are knowledge-based. We based our analysis on criteria from our previous work identifying best practices for acquisition development.

Finally, we relied on GAO's body of work examining DOD acquisition issues over the years. In recent years, we have issued reports that have identified systemic problems with major weapon systems acquisitions and we have made recommendations to DOD on ways to improve how it acquires major weapon systems. These reports cover contracting, program management, acquisition policy, cost estimating, budgeting, and requirements development. We have also issued many detailed reports evaluating specific weapon systems, such as aircraft programs, ships, communication systems, satellites, missile defense systems, and future combat systems. Finally, we used information from numerous GAO products that examine how commercial best practices can improve outcomes for DOD programs. During the past 10 years, we have gathered information based on discussions with more than 25 major commercial companies. Our work has shown that valuable lessons can be learned from the commercial sector and can be applied to the development of weapon systems.

System Profile Data on Each Individual Two-Page Assessment

Over the past several years, DOD has revised policies governing weapon system acquisitions and changed the terminology used for major acquisition events. To make DOD's acquisition terminology more consistent across the 67 program assessments, we standardized the terminology for key program events. For most individual programs in our assessment, "development start" refers to the initiation of an acquisition program as

well as the start of system development. This coincides with DOD's Milestone B. A few programs in our assessment (mostly programs that began before 2001) have a separate "program start" date, which begins a pre–system development phase for program definition and risk reduction activities. This "program start" date generally coincides with DOD's old terminology for Milestone I, followed by a "development start" date, either DOD's old Milestone II or new Milestone B depending on when the program began system development. The "production decision" generally refers to the decision to enter the production and deployment phase, typically with low-rate initial production. The "initial capability" refers to the initial operational capability—sometimes also called first unit equipped or required asset availability. For shipbuilding programs, the schedule of key program events in relation to milestones varies for each program. Our assessments of shipbuilding programs report key program events as determined by each program's individual strategy. For MDA programs that do not follow the standard DOD acquisition model but instead develop systems in incremental capability-based blocks, we identify the key technology development efforts that lead to an initial capability for the block assessed.

The information presented on the "funding needed to complete" from fiscal year 2009 through completion, unless otherwise noted, draws on information from SARs or on data from the program office. In some instances, the data were not yet available, and we annotate this by the term "to be determined" (TBD), or "not applicable" (NA). The quantities listed refer only to procurement quantities. Satellite programs, in particular, produce a large percentage of their total operational units as development quantities, which are not included in the quantity figure.

Out of the 67 programs in our assessment, 60 programs are captured in a two-page format discussing technology, design, and manufacturing knowledge obtained and other program issues. The remaining 7 programs are described in a one-page format that describes their current status. To assess the cost, schedule, and quantity changes of each program, we reviewed DOD's SARs or obtained data directly from the program offices. In general, we compared the latest available SAR information with a baseline for each program. For programs that have started product development—those that are beyond Milestone II or B—we compared the latest available SAR to the development estimate from the first SAR issued after the program was approved to enter development. For systems that have not yet started system development, we provided funding through the future years defense program. For systems not included in the SARs, we

attempted to obtain comparable baseline and current data from the individual program offices. For MDA systems, for which a baseline was not available, we compared the latest available cost information to the amount reported last year.

All cost information is presented in fiscal year 2009 dollars using Office of the Secretary of Defense approved deflators to eliminate the effects of inflation. We have depicted only the program's main elements of acquisition cost—research and development and procurement. However, the total program costs also include military construction and acquisition operation and maintenance costs. Because of rounding and these additional costs, in some situations, total cost may not match the exact sum of the research and development and procurement costs. The program unit costs are calculated by dividing the total program cost by the total quantities planned. These costs are often referred to as program acquisition unit costs. For some programs we refer to a "Nunn-McCurdy" cost breach to describe an increase in unit costs.[2] In some instances, the data were not applicable, and we annotate this by using the term "NA." In other instances, the current absence of data on procurement funding and quantities precludes calculation of a meaningful program acquisition unit cost, and we annotate this by using the term "TBD." The quantities listed refer to total quantities, including both procurement and development quantities.

The schedule assessment is based on acquisition cycle time, defined as the number of months between program start and the achievement of initial operational capability or an equivalent fielding date. In some instances, the data were not yet available, and we annotate this by using the term "TBD," or noting that the information is classified.

The intent of these comparisons is to provide an aggregate, or overall, picture of a program's history. These assessments represent the sum of the federal government's actions on a program, not just those of the program manager and the contractor. DOD does a number of detailed analyses of changes which attempt to link specific changes with triggering events or causes. Our analysis does not attempt to make such detailed distinctions.

[2]10 U.S.C. § 2433 establishes the requirement for unit cost reports. If certain unit cost thresholds are exceeded (known as Nunn-McCurdy breaches), DOD is required to report to Congress and, in certain circumstances, if DOD determines that specific criteria are met, certify the program to Congress.

Product Knowledge Data on Individual Two-Page Assessments

To assess the product development knowledge of each program at key points in development, we submitted a data collection instrument to each program office. The results are graphically depicted in each two-page assessment. We also reviewed pertinent program documentation such as the operational requirements document, the acquisition program baseline, test reports, and major program reviews.

To assess technology maturity, we asked program officials to apply a tool, referred to as Technology Readiness Levels (TRL), for our analysis. The National Aeronautics and Space Administration originally developed TRLs, and the Army and Air Force science and technology research organizations use them to determine when technologies are ready to be handed off from science and technology managers to product developers. TRLs are measured on a scale from 1 to 9, beginning with paper studies of a technology's feasibility and culminating with a technology fully integrated into a completed product. (See app. III for TRL definitions.) Our best practices work has shown that a technology readiness level of 7—demonstration of a technology in a realistic environment—is the level of technology maturity that constitutes a low risk for starting a product development program. In our assessment, the technologies that have reached TRL 7, a prototype demonstrated in a realistic environment, are referred to as mature or fully mature. Those technologies that have reached TRL 6, a prototype demonstrated in a relevant environment, are referred to as approaching or nearing maturity and are assessed as attaining 50 percent of the desired level of knowledge. Satellite technologies that have achieved TRL 6 are assessed as fully mature due to the difficulty of demonstrating maturity in an operational environment—space.

In most cases, we did not validate the program offices' selection of critical technologies or the determination of the demonstrated level of maturity. We sought to clarify the TRLs in those cases where information existed that raised concerns. If we were to conduct a detailed review, we might adjust the critical technologies assessed, the readiness levels demonstrated, or both. It was not always possible to reconstruct the technological maturity of a weapon system at key decision points after the passage of many years. In a few cases, we discussed information we received from program offices concerning technology readiness with officials from the Office of the Director, Defense Research and Engineering.

To assess design stability, we asked program officials to provide the percentage of engineering drawings completed or projected for completion by the design review, the production decision, and as of our current assessment. In most cases, we did not verify or validate the percentage of engineering drawings provided by the program office. We clarified the percentage of drawings completed in those cases where information that raised concerns existed. Completed drawings were defined as the number of drawings released or deemed releasable to manufacturing that can be considered the “build to” drawings.

To assess production maturity, we asked program officials to identify the number of critical manufacturing processes and, where available, to quantify the extent of statistical control achieved for those processes. In most cases, we did not verify or validate the information provided by the program office. We clarified the number of critical manufacturing processes and percentage of statistical process control where information existed that raised concerns. We used a standard called the Process Capability Index, a process performance measurement that quantifies how closely a process is running to its specification limits. The index can be translated into an expected product defect rate, and we have found it to be a best practice. We sought other data, such as scrap and rework trends in those cases where quantifiable statistical control data were unavailable. Although the knowledge points provide excellent indicators of potential risks by themselves, they do not cover all elements of risk that a program encounters during development, such as funding instability. Our detailed reviews on individual systems normally provide a more comprehensive assessment of risk elements.

We conducted this performance audit from August 2008 to March 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings based on our audit objectives.

Comments from the Department of Defense

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

MAR 17 2009

The Honorable Gene L. Dodaro
Acting Comptroller General of the United States
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Dodaro:

This is the Department of Defense (DoD) response to the GAO Draft Report GAO-09-326SP, "DEFENSE ACQUISITIONS: Assessments of Selected Weapon Programs," dated February 18, 2009 (GAO Code 120750).

First, the Department is encouraged that the draft report cites the progress that we have made over the past several years in reducing cost growth. We have instituted several major changes that are beginning to show results. As noted in the draft report, the updated acquisition documents which I signed in December 2008, and several policy memos I issued in 2007 and 2008, are aimed at starting programs out right, using competitive prototyping, using configuration steering boards, and strengthening performance agreements with program managers. The draft report shows a slight decrease in the cumulative cost growth over the past year, noting early systems engineering reviews and increasing technology readiness levels for new programs. I strongly believe as these initiatives are implemented across the major defense acquisition programs (MDAPs), they will be key to restraining cost growth. I have also developed a plan to improve and grow the acquisition workforce, which I believe will have very positive effects on program cost, schedule and performance.

Secondly, I thank you and your staff for working with the Department to improve the information flow between our organizations and to develop more meaningful metrics in this area. I am still concerned that DoD's performance in several areas is, as you note, "driven by older, underperforming programs as newer programs, on average, have not yet shown the same degree of cost and schedule growth" and that the "portfolios" are not the same size or composition. For example, the number of programs in the portfolios increases from the 2003 portfolio to the 2007 and 2008 portfolios — from 77 in 2003 to 95 in 2007 and 96 in 2008. Using the 59 programs that are common across the three time periods — 2003, 2007 and 2008 — we find a total cost growth from the original baselines of $243.8B, over 40% of which occurred before 2003. We should continue to

work together to remove from our metrics cost growth that occurred in the late 1980s and through the 1990s, as we have made many improvements in our acquisition process since that time. Our staffs worked together to develop some metrics that did not include such "long-ago" growth. These new metrics were not included in the 2009 draft report, but I hope that they will be included in future reports. These metrics will, I believe, allow for a more accurate assessment of current portfolio performance and policies. Looking forward, I am mindful that cost growth cited in this report will not vanish in the short run, and it will take years for the new initiatives to work their way into the majority of the programs in the portfolio. For example, the Joint Strike Fighter (JSF) and Future Combat system (FCS) programs are planned to be in the portfolio until 2034 and 2030, respectively. They will keep $78B of cost growth in the portfolio even if they have no cost growth for the next 25 years.

Thirdly, my personal analysis shows that a significant portion of the cost growth is attributable to increases in procurement quantities over the original program baseline. Purchasing greater quantities, and the associated cost of these items, is not acquisition program cost growth and does not reflect poor acquisition management.

Additionally, our analysis shows that the procurement plans for several programs were delayed and procurement rates slowed as a result of DoD budget decisions which are completely beyond the control of DoD program managers. Procuring weapon systems at rates lower than planned ensures significantly higher cost. Again, these choices made in DoD and Congressional budget processes do not constitute procurement cost growth as a result of poor program planning, execution, or management.

It is very important to recognize that these large, sensational numbers are a result of many factors, some of which are unrelated to the DoD acquisition process and management of programs. Make no mistake, there is clearly a need for greater discipline in program planning and execution, but the GAO analysis overstates the problem directly attributable to acquisition. I believe we have made improvements. We have much more work to do to ensure we deliver the maximum value for the taxpayer and robust capability for the warfighter. However, the future analysis needs to recognize all of the reasons for cost growth and avoid attributing program performance solely to the DoD acquisition process.

The Department has worked diligently over the past year to improve acquisition policies, reporting and cost estimation methodologies, and this work is reflected in the 2009 draft report. The draft report acknowledges that cost growth is decreasing, that early systems engineering reviews yield demonstrable program successes, and because all MDAPs under development must now have technology readiness levels (TRLs) greater than or equal to six, TRLs are increasing. The Highlights page from the draft report states a total cost growth in FY 2008 of $296B, which is an improvement over the FY 2007 total cost growth of $301B.

We must continue to improve the acquisition process to more effectively and efficiently deliver products to our customers, and we need to continue to develop better metrics. The Department looks forward to working with the GAO in both important endeavors.

The Department appreciates the opportunity to comment on the draft report. Technical comments are being developed and will be provided separately to your staff. My point of contact for this effort is Dr. Nancy L. Spruill, 703-614-5737.

Sincerely,

John J. Young, Jr.

Technology Readiness Levels

Technology readiness level	Description	Hardware/software	Demonstration environment
1. Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties	None (paper studies and analysis)	None
2. Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.	None (paper studies and analysis)	None
3. Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Analytical studies and demonstration of nonscale individual components (pieces of subsystem)	Lab
4. Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.	Low-fidelity breadboard. Integration of nonscale components to show pieces will work together. Not fully functional or form or fit but representative of technically feasible approach suitable for flight articles.	Lab
5. Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	High-fidelity breadboard. Functionally equivalent but not necessarily form and/or fit (size weight, materials, etc). Should be approaching appropriate scale. May include integration of several components with reasonably realistic support elements/subsystems to demonstrate functionality.	Lab demonstrating functionality but not form and fit. May include flight demonstrating breadboard in surrogate aircraft. Technology ready for detailed design studies.
6. System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated realistic environment.	Prototype. Should be very close to form, fit and function. Probably includes the integration of many new components and realistic supporting elements/subsystems if needed to demonstrate full functionality of the subsystem.	High-fidelity lab demonstration or limited/restricted flight demonstration for a relevant environment. Integration of technology is well defined.

(Continued From Previous Page)

Technology readiness level	Description	Hardware/software	Demonstration environment
7. System prototype demonstration in a realistic environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in a realistic environment, such as in an aircraft, vehicle or space. Examples include testing the prototype in a test bed aircraft.	Prototype. Should be form, fit and function integrated with other key supporting elements/subsystems to demonstrate full functionality of subsystem.	Flight demonstration in representative realistic environment such as flying test bed or demonstrator aircraft. Technology is well substantiated with test data.
8. Actual system completed and “flight qualified” through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	Flight-qualified hardware	Developmental Test and Evaluation (DT&E) in the actual system application.
9. Actual system “flight proven” through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last “bug fixing” aspects of true system development. Examples include using the system under operational mission conditions.	Actual system in final form	Operational Test and Evaluation (OT&E) in operational mission conditions.

Source: GAO and its analysis of National Aeronautics and Space Administration data.

GAO Contact and Acknowledgments

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Source: GAO.

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